Metals Review

May 1959

A. P. Ford
25-Year Anniversary
(See Article, Page 5)

Metals Review

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Important Lectures

Departments

"Pete" Ford Celebrates Silver Anniversary at A.S.M.

A. PETER FORD, sales manager of *Metal Progress* since 1945, is celebrating this year a quarter-century with the American Society for Metals, years that have been fruitful both to "Pete" and to the Society, years of growth for *Metal Progress*, years of work which have immeasurably aided in building the stature of *Metal Progress* as a top-notch commercial success in the field of technical journalism. He has done his job well . . . he thrives on responsibility and hard work.

Certainly these 25 years have been the kind that Pete had hoped for when he first came to A.S.M. in 1934 from the public relations department of the Van Sweringen real-estate firm of Cleveland. His initial years with the Society were spent on *Metal Progress* printing and production, learning about A.S.M.'s organization and the Society's activities. In 1937 he took to the road to sell advertising, and through the years he visited virtually every part of the United States, convinced that the members of the American Society for Metals (the readers of *Metal Progress*) are the most important market in the world for those who sell the metal industry. In 1945 he was made sales manager.

"Pete" Always Seems to be on Hand Whenever an Inspection Party, Either Official or Unofficial, Tours the New Headquarters Building. Shown during a recent inspection party are, from left: Fred Kerr, vice-president of Gilmore-Olson, contractor; Pete; Ray T. Bayless, A.S.M. managing director; R. Buckminster Fuller, inventor of the geodesic dome principle of construction, and Les Reardon, advisor and consultant on building construction practices

Years Reflect Growth

When Pete and *Metal Progress* first became acquainted, *Metal Progress* was four years old and carried about 35 pages of advertising a month. (Remember the Great Depression?) Today, *Metal Progress* is reaching the metal industry with issues containing anywhere from 150 to 175 pages of advertising—the average for the last six years is 163. His efforts have culminated in a sales staff with offices in New York, Chicago and Cleveland and representation in Los Angeles and San Francisco. Years of constant planning and brilliant selling have made *Metal Progress* one of A.S.M.'s most valuable properties and one of the metal industry's most respected and financially successful publications. No sales manager could have done more than Pete.

"Master Builder"

With the death of Bill Eisenman in 1958 many A.S.M.'ers were doubtful that the new headquarters building, then hardly started, would ever become a reality without Bill's vigor and enthusiasm to see it through.

The A.S.M. Board of Trustees had no such thoughts. They knew of another man on the staff at A.S.M. headquarters who could take over this project, a man trained in Bill's school of hard work and tremendous energy. The Board therefore appointed this man as staff representative in charge of A.S.M.'s front-line offensive of the future—the new headquarters building. They appointed Pete Ford and told him to go ahead and build the new headquarters.

So in addition to his undiminished load as sales manager for *Metal Progress*, Pete charged headlong into what was, in June of last year, still only the beginning of an idea. Reporting directly to the Board and Clarence H. Lorig in particular (now A.S.M. president), he handled each phase of the operation as though he had been building unique office structures all his life! His management of this responsibility became indicative of the talents he possesses. He spent countless hours in consultation with John Kelly, building architect, and Fred Kerr, the contractor's representative. Daily he makes decisions on metal applications, furniture, kitchen appliances, carpeting, landscaping, plastering, bookshelves, the mineral garden, postal arrangements.

A Little Help on the Side

Standing beside Pete through these years has been Jane Ford, his charming wife and *alter ego* since their school days in Ft. Wayne, Ind. Their son, Tom, now in his final year of law school, and daughter-in-law, Shirley, have just made Jane and Pete grandparents.

It's natural that Pete should be successful. He has that combination of a pleasing personality and sense of humor that appeals to almost everyone. In his wide range of leisure-hour activities he has a self-inflicted desire to play good golf and a spouse-promoted interest in listening to good music. He's always jovial, rarely tired, and a master at constructive criticism.

It's difficult to imagine what A.S.M. would be today had not Pete Ford come upon the scene 25 years ago. He is not only the sales manager of one of the most successful trade publications in the metal industry, and the craftsman of A.S.M.'s new home, but his promotional ability has nurtured at one time or another practically every phase of A.S.M.'s activities.

Congratulations Pete, on your 25th year with A.S.M.!

Delivers Sauveur Lecture At Philadelphia Meeting

Speaker: M. Cohen

Massachusetts Institute of Technology

The 26th Sauveur Night Meeting of the **Philadelphia Chapter** was held at The Franklin Institute, and included an after-dinner visit to the Fels Planetarium.

Past National President Francis B. Foley introduced the speaker with a brief talk on the life and work of Albert Sauveur and his rise to the distinguished position as Dean of American Metallurgists. Following this introduction, Morris Cohen, Massachusetts Institute of Technology took over in a similar vein by adding to the list of the contributions of Sauveur and crediting him with the broad concepts of the theme of his own talk, "The Role of Metallurgical Structure in the Behavior of Steel". He pointed out that while Sauveur stressed the perfection of crystal architecture, we are today primarily concerned with its defects.

Dr. Cohen then related how Sauveur sent questionnaires to leading metallurgists for the purpose of finding explanations as to what makes steel hard. The answers he received fell into four categories:

1. The strength of the bond between the iron atoms.
2. Solid solution hardening.
3. Fragmentation or distortion of the crystallites.
4. Precipitation hardening.

Today we have similar but more direct answers expressed in modern terms.

Dr. Cohen demonstrated the TTT-curves for steel, along with the corresponding structures. In addition, he explained the M_s—M_f transposition to form the body-centered tetragonal martensite in the hardening reaction. The formation of epsilon carbide during the tempering of high-carbon steel was also described and illustrated with high magnification electron micrographs.

The results of some work to determine the strength contribution of dissolved carbon in martensite were presented. Sufficient nickel was added to steel to suppress the transformation above room temperature, thus allowing control of martensite formation by the refrigeration temperature. This permitted measuring the hardness, yield strength, tensile strength and compression strength for various percentages of transformation, and then extrapolating to 100% martensite. The yield strength of martensite varies from 80,000 to 280,000 psi. due to carbon in solution.

By tempering slightly above room temperature after hardening, additional benefits of precipitation hardening from the epsilon carbide may be realized. Although this effect is comparatively slight, it represents an increment of hardness and strength over and above that provided by the carbon in solution.

A decrease in the modulus of elasticity on hardening indicates a lowering of the actual bond strength between the atoms with increase in carbon content, signifying that this factor cannot account for the high hardness of martensite.

In answer to the question of how to increase hardness and strength still further, Dr. Cohen explained the austforming process wherein steel is deformed by rolling in the austenitic condition followed by immediate cooling through the martensitic temperature range. In the case of 4340 steel, increases of 20,000 psi. in tensile strength and 40,000 psi. in yield strength are obtained with 30 to 50% rolling reduction carried out at 1000° F. before hardening. The ductility is not greatly affected. The influence of orientation was briefly discussed; it appears that the transverse properties suffer surprisingly little damage by austforming.

Chairman Charles A. Turner, Jr., presented Dr. Cohen with the Sauveur Award Certificate at the conclusion of the meeting.—**Reported by W. J. Kinderman for Philadelphia.**

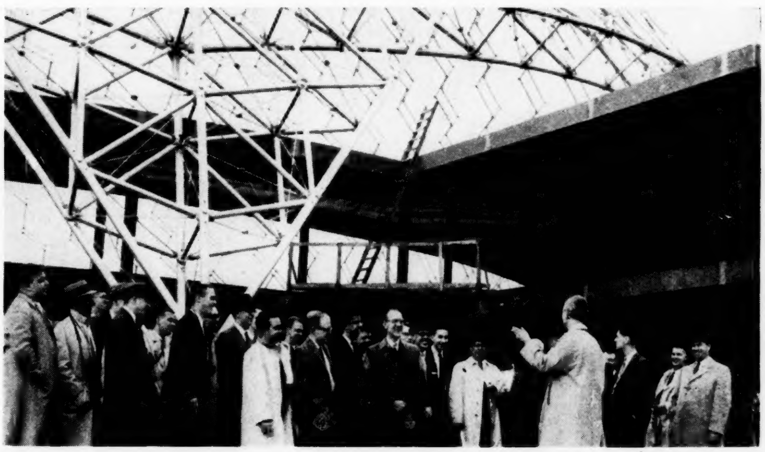
Set Sintering Conference

The Department of Metallurgy, University of Notre Dame, is sponsoring a conference on "Sintering and Related Phenomena", to be held on the campus from June 15-17, 1959.

The aim of the conference is to gather together scientists, engineers and physicists interested in sintering phenomena and thus facilitate the exchange of ideas and experience of various research groups. Ample time will be provided for discussion of conflicting ideas.

Further information about the conference can be obtained from: G. C. Kuczynski, Professor of Metallurgy, P.O. Box 145, Notre Dame, Ind.

Student Architects Visit A.S.M. Dome



Architect John Terence Kelly (Back to Camera) Talks to 27 Architectural Students From Penn State University Who Visited the New A.S.M. Building During a Spring Study Tour of Interesting Examples of Architecture in the Cleveland-Detroit Area. Shown in the picture are A.S.M. staff members A. P. Ford (with white roll in hand) and Anton Brasunas (on right)

Rating the new A.S.M. geodesic dome the most outstanding modern example of architecture in the Cleveland area, the senior class of the school of architecture, Pennsylvania State University, State College, Pa., stopped to visit the dome Apr. 26 at the outset of a week-long spring study tour in the Cleveland-Detroit region.

The 27 students spent two hours observing the dome and the fast-rising building on their first tour stop. With the class was Vincent L. Pass, department of architecture.

"We selected the A.S.M. dome because it is without doubt one of the most interesting structures to be seen today", said Prof. Pass. During the inspection tour, architect John Terence Kelly, designer of the building, discussed structural details of the huge dome and described applications of unusual metals scheduled for use.

Greeting the visitors at the site were A. P. Ford, A.S.M. staff member in charge of construction; Chester L. Wells, A.S.M. expositions manager; and Anton deS. Brasunas, Metals Engineering Institute.

Following the A.S.M. visit on Sunday the class spent the next day at the General Electric Co.'s Institute of Lighting at Nela Park in Cleveland, where modern applications of lighting were observed.

On leaving the city, the students proceeded to Detroit for a four-day visit to more than 15 new buildings and facilities having unusual architectural characteristics.

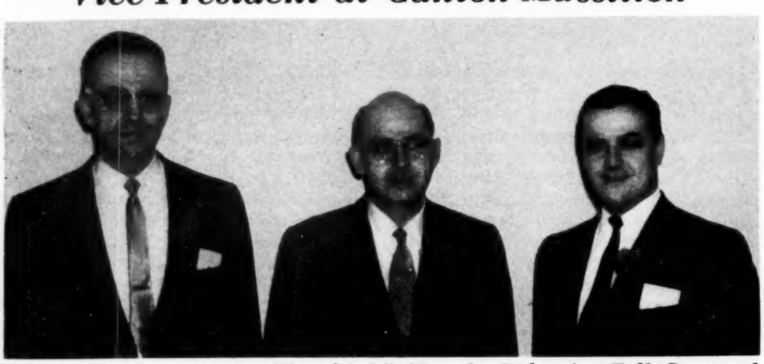
Worcester Honors Past Chairmen

Past Chairmen of the Worcester Chapter Present at a Recent Meeting Included, From Left: W. J. Nartowt, Greenman Steel Treating Co.; H. J. Elmendorf, American Steel & Wire Co.; W. C. Searle, Retired; R. S. Morrow, Universal-Cyclops Steel Corp.; C. C. Tucker, Reed & Prince Manufacturing Co.; L. P. Tarasov, Norton Co.; C. M. Inman, Consulting Metallurgical Engineer; L. G. Shaw, Pratt & Inman; and C. G. Johnson, Worcester Polytechnic Institute. (Photograph by C. W. Russell)

At Montreal's National Officers Night

National President C. H. Lorig, Technical Director, Battelle Memorial Institute, Was the Guest Speaker at the National Officers Night Meeting of Montreal Chapter. He gave his talk on "Selection of Materials in This Changing World". Shown are, from left: Dr. Lorig; R. Thompson, chairman; Past President G. M. Young; and Past Chairman K. W. Shaw

Vice-President at Canton-Massillon



"Recent Developments in Alloy Steels" Was the Title of a Talk Presented by Walter Crafts, Vice-President A.S.M., and Associate Director, Technology, Electro Metallurgical Co., at a Meeting Held by Canton-Massillon Chapter. Shown are, from left: W. W. Scheel, chapter chairman; Mr. Crafts; and G. P. Michalos, vice-chairman. (Report by R. R. Ernest)

Describes Sandia Reactor At Albuquerque Meeting

Speaker: A. W. Snyder
Sandia Corp.

A. W. Snyder, supervisor, Radiation Special Studies Section 1626-3, Sandia Corp., spoke at a joint meeting of the **Albuquerque Chapters** A.S.M. and A.W.S. on the "Sandia Engineering Reactor Facility, a Design for Radiation Environmental Testing".

The Sandia Engineering Reactor Facility is a five-megawatt reactor of the M.T.R. type in a novel shield configuration for performing radiation effects tests. A capability is provided to compound the environments of temperature, altitude, vibration and nuclear radiation in an irradiation cell 30 x 22 x 9 ft. high. An epithermal neutron flux of $5 \times 10_{11}$ nv and a gamma ray field intensity of 10^8 R/hr. is available in the cell at five megawatts. Materials to be irradiated and tested while under irradiation are moved into and from the cell through an arrangement of radiation locks which permit the reactor to operate continuously.

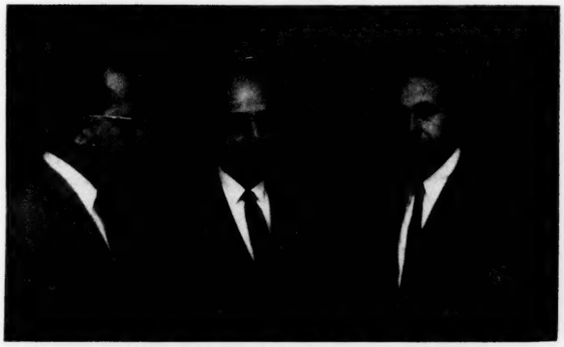
Mr. Snyder pointed out that shutdown of the reactor is not required to instrument new experiments. Post-irradiation analysis of materials is performed in a large-bay hot area using the handling capability of a mobile remote handler and six master-slave manipulators. The master-slave manipulators penetrate a biological shield between an occupied laboratory and the large-bay area. The mobile remote handler is a shielded operator-cab mounted on an electrically driven chassis of a Caterpillar tractor. The operator of the mobile remote handler has available for remote handling the capability of an electromechanical manipulator.

The core of the reactor is basically similar to the cores of the BORAG—1 and the SPERT—1. Thirty-two fuel elements in equal quadrants are contained in a pressure vessel having a 30 in. diameter in the core zone. The core zone of the reactor vessel is exposed in the irradiation cell. A boral (B_4C and aluminum) shield at the interface of the core reflector and the vessel reduces to a negligible level the thermal neutron leakage into the irradiation cell. The reduced thermal neutron level reduces the radioactivation of experiments.

The facility design is complete and is planned for operation in the fall of 1960.

In the question and answer session following Mr. Snyder's talk it was learned that the requirement for corrosion resistance and dimensional stability posed severe problems in materials selection. — **Reported by G. J. Hof for Albuquerque.**

On Hardening of Steel



Walter Crafts, Vice-President A. S. M., and Associate Director of Technology, Electro Metallurgical Co., Spoke on "Hardening of Steel" at New Haven. Shown are, from left: F. E. J. Storm, technical chairman; Mr. Crafts; and K. L. Tingley, chairman

Outlines Research Aims

"Sophistication and Entrepeneurship in Using Research" Was the Title of a Talk by W. M. Murray, Jr., Southern Research Institute, at a Meeting of Birmingham. Shown are, from left: W. Mayer, chairman; Dr. Murray; and R. A. Davis, A.W.S. chairman

Speaker: Walter Crafts

Electro Metallurgical Co.

Walter Crafts, associate director of technology, Electro Metallurgical Co., and vice-president A.S.M., presented a talk on "Hardening of Steel" at a meeting in **New Haven.**

Studies of the hardening of steel have followed two avenues of approach—one the systematization of empirical observations of mechanical properties and the other the controlled observation of hardening phenomena and their thermodynamic interpretation. Both of these lines of investigation have followed cyclic trends with rapid strides due to the enlightened insight of individuals and periods of slow development that broaden the base of knowledge and cultivate the ground for further rapid growth in the next generation. We now appear to be at the stage when an inspired new breakthrough can be anticipated.

Mr. Crafts traced the historical development of the empirical approach from the development of low-alloy steels around 1900 up to the concept of hardenability and the Jominy test.

Although this was of great practical utility, the exceptions were many and troublesome. Individual alloys, such as molybdenum, behaved differently depending on steelmaking practice. Chromium was sensitive to carbide solubility and segregation. Hardenability coefficients were difficult to establish for nickel and the more stable carbide-formers. Complex high-alloy steels deviated excessively from calculated hardenability. Furthermore, the specific effects of alloys on certain mechanical properties, and the benefits of low carbon content became obvious exceptions to the substitutional principle. These deviations represent gross oversimplification when extrapolated beyond the limits of their immediate utility and present many unsolved problems.

In tracing the understanding of transformation phenomena, starting with clarification of the iron-carbon diagram about 1900, Mr. Crafts said that, in general, studies of growth mechanisms have been fairly successful, but studies of nucleation have left much to be desired.

In the growth of pearlite, it has been possible to rationalize transformation in terms of temperature and the diffusion rates of carbon. In specific cases similar rationalization has been made to interpret the effects of substitutional alloying elements, but it has not been possible to build up a general case in spite of the generation of a large amount of data, largely Russian, on the diffusion of alloys, singly and in combination. With respect to nucleation, the mechanism is still not too well understood.

The hypotheses of nucleation and empirical hardenability have been questioned by two recent developments. Kogan and Entin in Russia have demonstrated a specific influence of manganese in increasing the hardenability of vanadium and titanium steels that normally contain stable carbides. The addition of manganese was reported to increase the solubility of the carbide in austenite to a major degree and the resulting increase in soluble vanadium and titanium delayed transformation to pearlite materially. Another question was raised by Cohen who demonstrated that transformation of austenite required imperfections equivalent to nuclei. Thus, it would appear that an inspired study of the nature of austenite is required to explain the discrepancies in hardenability and transformation theories.—**Reported by James L. Baker for New Haven.**

Speaker: William M. Murray, Jr.

Southern Research Institute

William M. Murray, Jr., director of the Southern Research Institute, addressed a joint meeting of the **Birmingham Chapters** A.S.M. and A.W.S. on the subject "Sophistication and Entrepreneurship in Using Research".

Dr. Murray pointed out that research is not magic; that although it can often provide a satisfactory research answer, it alone is not adequate for establishing a new or improved business venture. The sponsor of research must be sophisticated in the use of research—that is, he must have the technical capability to utilize research results and must be prepared to provide the time and money necessary for an adequate development program. He must also supply the proper degree of entrepreneurship—analysis of the market potential and provision of the necessary sales effort to develop the market. Since it may cost $500,000 for the development and profitable sale of a research technical answer costing $5000, the sponsor of research should know this before he starts his research program and be prepared to follow through.

Knowing the group was familiar with the SRI program in metallurgy, Dr. Murray mentioned several interesting examples of SRI work in plastics, chemicals, food radiation and the research program seeking a chemical treatment for cancer, utilizing these examples to show the outstanding abilities of the various sponsors in sophistication and entrepreneurship.

Dr. Murray concluded by stressing that America, as we know it, was built by entrepreneurs, but that the world of today is so complex and the demands on modern science so great, that research sophistication is now equally important.

An interesting question and answer period followed Mr. Murray's talk.—**Reported by E. J. Wheelahan for Birmingham.**

Describes Electron Beam Melting

Charles D'A. Hunt, Vice-President, Temescal Metallurgical Corp., Spoke on "Electron Beam Melting" at a Meeting in Chicago. Shown are, from left: D. W. Levinson, technical chairman; Dr. Hunt; and W. Wilson, chairman

Speaker: Charles D'A Hunt

Temescal Metallurgical Corp.

Charles D'A Hunt, vice-president, Temescal Metallurgical Corp., spoke on "Electron Beam Melting" at a meeting of **Chicago Chapter.**

Dr. Hunt explained that electron beam melting is a means of bombarding a metal with electrons under very high vacuum to produce temperatures high enough to melt even the most refractory metals. Melting is done in a highly evacuated vacuum furnace. At very high vacuums, the evaporation of the impurities is accelerated at an extremely high rate and purification becomes an important part of this melting technique.

This method of melting and refining lends itself to continuous casting in water-cooled copper molds where the electrons are directed to the top of the molten pool from a tungsten wire emitter. Ingots on the order of 3½ to 8 in. diameter by 42 in. long have been produced in this manner. The diameter of the ingot depends somewhat on the melting point of the metal being refined. For example, tantalum ingots have been produced to a maximum diameter of 3½ in.; titanium can be produced up to 8 in. in diameter. The power factor of equipment limits the size of the ingots since they are now using equipment rated at about 225 kw. Power factor comparisons were given as follows:

Titanium	1 kw/in.^{2}
Columbium	2 kw/in.^{2}
Tantalum	4 kw/in.^{2}
Tungsten	8 kw/in.^{2}

The a-c. electric current at 20 v. heats the tungsten emitter filament wire to a temperature of approximately 2100° C. The success of this method seems to depend on maintaining a balance between voltage across the plasma field and the electron admission rate bombarding the bath. Success seems to hinge on controlling voltages in the order of 10,000 to 15,000 v.

The advantages of this method of melting refractory metals over the more conventional induction and arc methods were listed as follows:

1. High vacuum giving high purification and freedom from contamination from the furnace atmosphere.
2. Water-cooled molds, with no contamination from the mold, and, the metal as refined can be continuously cast, doubling the productive time of the furnace.
3. Always provide a stirred liquid pool, which, from the thermal agitation increases the rate and degree of purification.
4. The control of the melting rate to permit purification reactions to proceed.

In addition to these factors, almost any form of material can be used for remelting. A costly prepared ingot of the metal to be purified is not required.

One disadvantage of this technique is that alloys having high volatile constituents cannot be melted.

The removal of impurities and alloys from the melt is accomplished at a vacuum of 10^{-4} mm. Hg where the melting rate is on the order of 6 in. of ingot per hr. The cost of the melting may vary from $2 to $11 per lb., depending on the initial purity of the metal being refined. The higher purity metals can be refined in less time and at a lower cost than the more impure metals.

The surprisingly good results obtained in purifying a 17-7 PH steel were noted. After purification, the directional properties become isotropic. In the purification of steel, all manganese and silicon is removed, less than 10% of the initial chromium charge is lost, approximately 60% of the sulphur is removed and there is no appreciable or detectable loss in elements such as aluminum, nickel, molybdenum, titanium or vanadium.

Tungsten, when fully refined with most of the oxygen removed, can be readily machined and cut with a hack saw, and is ductile enough to be worked by conventional methods.

Dr. Hunt concluded his talk with a discussion on the evaporation of oxides. It appears that monatomic oxides of the metals are evaporated from the molten bath. The rate of removal depends upon the vapor pressures existing at these extreme vacuums and are fairly predictable. Many monoxides, such as titanium and vanadium, are extremely difficult to remove even by this method. **—Reported by I. R. Wood for Chicago Chapter.**

York Tours Hamilton Precision Metals Div.

Speaker: H. L. Hovis

Hamilton Watch Co.

Members of the **York Chapter** toured the Precision Metals Division of Hamilton Watch Co. as part of a recent meeting. Included in the tour was a review of the metal's processing from melting to finished strip and foils as thin as 0.00006 in. H. L. Hovis, supervisor of the Precision Metals Division, spoke on the progress made in the past five years in the development of new alloys and use of long known but little utilized metals. These developments resulted from rapid advances in the electronic, nuclear and jet programs which require alloys having superior corrosion resistance, high-temperature strength and acceptable neutron absorption characteristics.

The speaker described the various alloys that are applicable to the various programs. He covered the processing of these materials through forging, hot rolling, annealing and rolling into thin gage and foil in the size of 0.002 in. thickness and thinness. Unusual characteristics of these alloys were pointed out and data submitted on the problems which were encountered in the processing. These included zirconium, titanium, hafnium, stainless steels and high-temperature alloys.

In conclusion, Mr. Hovis mentioned that the metallurgist and producer of metals have been challenged during the past several years to meet the demands for alloys having physical requirements never before specified. This program will continue as long as there is continued growth in nuclear, jet and electronic fields. The problem is not only to determine the alloys that will function but how to process them to the sizes required by the various industries.**—Reported by N. Stengel for York Chapter.**

Outlines Possible Causes For Metal Failures at Meeting in Cincinnati

Speaker: W. M. Baldwin, Jr.
Case Institute of Technology

W. M. Baldwin, Jr., Case Institute of Technology, spoke on the "Possible Causes for Metal Failures" at a **Cincinnati** meeting.

Dr. Baldwin pointed out that no one simple explanation is usually possible for the failure of metals. Generally it is the result of several conditions which are present in the metal structure. These failures are progressive rather than a sudden change from good to bad.

Dr. Baldwin discussed the "dislocation theory" in regard to failure of metals, a dislocation being described as that boundary between the portion of a crystal which has slipped and that portion which has not slipped. This dislocation usually is not a straight line. There are both compressive and dilative forces present near the dislocation. Impurities tend to collect at dislocation areas, and to show the effect of the dislocations on the ductility of a metal, several tests were made by varying temperature and recording the effect of the ductility of the metal.

At low temperatures a peak is reached in ductility since the dislocation is able to pull away from the impurities. However, at high temperatures, a smooth curve is obtained since the diffusion rate is such that the impurities will move with the dislocation. At the intermediate temperatures, the curve has a serrated appearance which is caused by the dislocation pulling away from the impurities, but then runs into additional impurities. This is called the "blue brittle" range. If the speed of the test is increased, the impurities must speed up to remain with the dislocation, which in turn will increase the temperature of the "blue brittle" range, which is directly proportional to the carbon diffusion rate.

Another field to consider is H_2 embrittlement. H_2 in steel is detrimental and quantities in the order of magnitude of 12 ppm. has reduced the ductility in certain temperature ranges and strain rates. Dr. Baldwin explained this reduction in ductility by illustration, using a three-dimensional plot of temperature, strain rate and ductility, which showed a valley as the temperature is increased. The ductility decreases as temperature is increased to the bottom of this valley and then as temperatures continue to increase, an increase in ductility is experienced. H_2 is in solid solution and in the voids during the testing of these steels. As the test progresses, the voids enlarge and pressure of the H_2 is lowered. Due to the pressure differential, additional H_2 diffuses into the voids. As the temperature increases, the diffusion rate increases and the metal becomes less ductile. This is true up to a certain point, then beyond this point the ductility increases with increasing temperature.

For any given temperature, the ductility will increase with an increase in strain rate due to the inability of the H_2 to diffuse as rapidly as the voids grow during the speeded-up test.

Dr. Baldwin continued with a discussion on the detrimental effect of hard surface layers such as a carburized case or copper or chromium plating on the test samples. A carburized case of 0.010 in. on a 0.212 in. tensile bar decreased the ductility by one-half. The same condition prevails on chromium plated parts. During the first part of the tensile test the outside brittle layer (chromium or carburized case) breaks and produces a notch effect. The deeper the notch, the lower the ductility, or in this particular case, the deeper the carb depth or plating thickness, the lower the ductility.

Some steels are more notch sensitive than others. For example, AISI 1340 steel is very notch sensitive, while the old work horse of carburizing steel, AISI 4620, has a very low notch sensitivity. The notch sensitivity factor has been used to explain the embrittling characteristic of H_2 on plated parts. By baking the plated parts after plating, the heavy concentration of H_2 on the surface is removed by diffusing the H_2 into the parts. This lower H_2 concentration on the surface removes the brittle characteristic.

The fourth and last case history discussed concerned the speed of deformation in cold heading. Dr. Baldwin compared 302 stainless steel and 1038 steel. In cold heading rivets, the 302 stainless cracked while the 1038 made good rivets. Under tensile test 302 stainless is very ductile, however, in compression at the speeds of commercial cold heading presses 302 is very brittle. By slowing up the rate of compression, the 302 stainless becomes more ductile. In fact, at very slow speeds, 302 is more ductile than 1038 steel. However, as the rate of deformation is increased, 302 approaches the ductility of glass.—**Reported by R. L. Bockstiegel for Cincinnati.**

Describes Cast to Shape Toolsteels

F. C. Shields, Manager of Sales, Allegheny-Ludlum Steel Corp., Spoke on "Cast to Shape Toolsteels and Forged Composite Die Sections" at a Meeting of Western Ontario Chapter. Shown are, from left: W. A. McIntyre, chairman; R. J. Schluchter; Mr. Shields; and A. D. Earl, technical chairman. (Reported by W. A. McIntyre for Western Ontario)

Metallurgical News . . .

Zirconium Association—A group of companies that produce, melt and process zirconium have formed the Zirconium Association. With the increased importance of and interest in the use of this metal it was recognized that an association could accomplish a great deal in expanding the uses of zirconium. Any questions regarding the use of this metal may be addressed to: Zirconium Assoc., 2130 Keith Bldg., Cleveland 15.

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Sectional Meeting—Papers are invited for the Society for Applied Spectroscopy and Instrument Exhibition on Emission and X-Ray Spectroscopy, Mass Spectroscopy, Infrared and Ultra-Violet Absorption and Gas Chromatography. Title and abstracts should be submitted before Sept. 1, 1959. For information write: M. F. Wilson, Program Chairman, Air Reduction Corp., Research Laboratory, Murray Hill, N. J.

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Nuclear Technology—The following summer courses will be held at the University of California: Nuclear Technology Study Program, June 22-Aug. 28; Radiological Regulation and Use, July 20-31; Nuclear Technology Survey, July 13-17. For further information write: Engineering and Sciences Extension, Nuclear Energy Programs, 2441 Bancroft Way, University of California, Berkeley 4.

Trio Speaks on Cold Rolled Sheet

J. J. Wolf, G. R. Markle and E. W. Mahaney (From Left), Youngstown Sheet & Tube Co., Were the Speakers at a Meeting Held by the Calumet Chapter. They spoke on "Production and Control of Cold Rolled Sheets"

Speakers: E. W. Mahaney, G. R. Markle and J. J. Wolf
Youngstown Sheet & Tube Co.

A recent meeting of the **Calumet Chapter** was devoted to a discussion of the metallurgical, operational and control problems encountered in the "Production and Control of Cold Rolled Sheet and Strip" at the Youngstown Sheet & Tube Co.'s Indiana Harbor Works. This was a timely topic for steel men in the Calumet region since more sheet and strip is produced and consumed in the Chicago area than any other place in the world.

E. W. Mahaney, chief metallurgist, started the session by discussing some of the metallurgical problems involved. Experiments in the production of capped and killed ingots were described in detail. Increased ingot yields achieved by such practices were cited as incentives in these programs. The use of rimming compounds was discussed. The incidence of subsurface nonmetallics occurring as products of deoxidation were indicated to be a primary cause of "slivers" in rolling. Some data on the control of these nonmetallics through the use of fluoride mold compounds was described. Slab conditioning through the use of automatic scarfing machinery was said to be one method by which improvement in product quality may be accomplished.

G. R. Markle, superintendent, cold reduction department, described the equipment at the Indiana Harbor Works and some of the operational problems involved. Cleanliness of plant equipment, control of roll contour, alignment of butt welding equipment and other factors were cited as mechanical problems involved in obtaining a high quality product. X-ray gaging and automatic screw downs on the cold strip mills are factors important to quality control.

J. J. Wolf, division metallurgist, described standard tests and empirical standards which are being used to predict the relation between product quality and performance. Selection of steels of proper cleanliness and control of temperatures at various stands in the hot mill were related to the drawing quality of the finished product. Cold reduction practice was described and it was stated that Youngstown's Indiana Harbor Works attempts to maintain a minimum reduction of 50% to obtain the best drawing quality.—**Reported by R. D. Enquist for Calumet.**

Explains Electron Theory Of Metals and Alloys

Speaker: R. Speiser
Ohio State University

"Electron Theory of Metals and Alloys" was the subject of a talk presented by Rudolph Speiser, professor of metallurgy, Ohio State University, at a meeting at **Purdue.** Dr. Speiser divided his talk into three sections, each illustrated with appropriate slides and drawings—structure of atoms, nature of bonds and band or electron theory of metals.

It has only been recently that a modern, unified theory has been developed to explain the structure of all solid materials. This theory is based upon the distribution of electrons in various energy states within the structure of the atom. A fundamental departure of the theory with earlier attempts is that the electron is considered to have a dualistic nature—that of a particle or mass, and that of a wave function. This double nature is related through applications of De Broglie's and Schrodinger's equations. The theory can be applied easiest to the simplier atoms, such as hydrogen. There are only certain definite states for electrons within the atom orbitals. For these electrons, the degrees of freedom are quantized, and are designated as: m (principle), l (orbital), ml (magnetic), and s (spin). An additional rule regulating these four quantities is Pauli's exclusion principle, which states that no four quantum numbers can be identical. Thus, by applications of these principles of quantum numbers, the configuration of the atoms can be obtained. Complete application of the quantum-mechanical equations is usually extremely difficult for atoms more complex than hydrogen.

Dr. Speiser briefly reviewed the four types of bonding among atoms: Van der Waals bonding, occurring in the noble elements, results from induced polarization of the stable outer electron shells. Ionic or electrostatic bonding, such as in lithium fluoride, results in an actual gain and loss of electrons. Covalent bonding, as in the chlorine molecule, is a sharing of electrons with opposite spins between two atoms. Most important, however, and embracing most of the elements, is metallic bonding. This type of bonding results in part from the large number of atom neighbors (large co-ordination number) and from resonating bonds between the atoms. These resonating or moving bonds result in a "cloud" of free electrons moving through a positively-charged lattice.

The band or electron theory of metals is built upon the metallic bonding principle. X-ray adsorption and emission is direct evidence for the band theory. Within solids, single atomic valence energy levels are split into bands of closely spaced energy levels. As with single atoms, however, there are definite energy "bands" for the outer electron states. To have the electrons in a piece of metal at the minimum energy level, Fermi distribution statistics are followed, resulting in two electrons per energy state. Only the electrons in the highest fraction of energy distribution can be displaced by other electrons and easily excited into unoccupied energy states.

Electrons are diffracted as they move through the crystal, and hence cannot have energy level values corresponding to Bragg diffraction wave lengths. This fact explains the difference between metals and nonmetals. Metals have overlapped electron energy bands or partially filled bands and insulators have widely separated or filled bands.

Dr. Speiser concluded his talk with examples of compound heat of formation data obtained from X-ray band shift. Using recent techniques, heats of formation can be estimated to a good degree of accuracy by simple arithmetic.

The annual $500 A.S.M. scholarship was awarded by the metallurgical engineering faculty at Purdue to sophomore Robert A. Choulet, on the basis of past academic achievement, during the meeting.—**Reported by Gary Kleinelder for Purdue.**

A.S.M. Members' Names Added to Quarter Century Club Roster

The following A.S.M. members have been awarded honorary certificates commemorating 25 years consecutive membership in the Society:

ATLANTA—John F. Cotton.

BALTIMORE—C. L. Elgert, Leo J. Gould, Edwin W. Horlebein, Koppers Co., American Hammered Piston Ring Div., Stanley Myllo.

BIRMINGHAM—B. R. Queneau, R. W. Sandelin.

BOSTON—Morris Cohen, S. E. Conner, Milton W. Eastman, Peter E. Kyle, Joseph T. Ryerson & Sons, Inc., Joseph Stecke.

BUFFALO—John L. Benham, Robert F. Cameron, Joseph P. Comer, John E. Jacobs, William D. Leed, Jr., Wilber B. Miller, Emil A. Piper.

CALUMET—Silas M. Fitch, Walfrid Warner.

CANTON-MASSILLON — Electric Furnace Co., James A. Evans, G. G. Hawk, H. E. McKimmey, E. L. McReynolds.

CHICAGO — Will K. Brown, Thomas B. Chace, Philip H. Daily, Eugene D. Gasper, Theodore A. Ledin, Magnaflux Corp., Henry G. Magnussen, G. S. Mican, Norman P. Norlie, Joseph P. O'Hara, Carl H. Samans, E. H. Seegert, W. A. Singer, Sivyer Steel Casting Co., David Spear, Elmore S. Strang, Robert J. Sutton, Donald F. Taylor, Ralph E. Tower.

CHICAGO-WESTERN—Verne Pulsifer, Matthew Rigoni.

CINCINNATI—C. P. Bartels, H. C. Cross, W. A. Maddox.

CLEVELAND — Clair A. Beers, Charles H. Campbell, Chase Brass & Copper Co., Cleveland Electric Illuminating Co., Samuel A. Crabtree, Louis P. De Vau, W. S. Evans, Ray Haserodt, Harry L. Jenter, Hugo E. Johnson, Ralph G. Kennedy, Lamson & Sessions Co., John E. Millen, Robert A. Peterson, S.A.E. Steels, L. C. Schweitzer, Warren A. Silliman, The W. S. Tyler Co., Benjamin Yukl.

COLUMBUS — Clarence C. Hoffman, William E. Mahin, Leonard P. Rice, E. C. Stein.

DAYTON—John G. Hoop, L. L. Jaffe.

DELAWARE VALLEY — R. D. France, J. B. Janney, Archibald J. Morgan.

DETROIT—Carl Bailys, Arthur F. Bersthal, Thomas B. Blackwood, Wilson Coats, S. D. Heron, A. F. Hoden, Richard B. Kropf, Vincent L. McEnally, Jr., Vaughan C. Reid, A. P. Schweizer, H. John Sheppard.

EASTERN NEW YORK — Leo Forchheimer, Fritz V. Lenel, John R. Low, Jr.

GOLDEN GATE—Nathan F. Helper, H. M. Nystrom, Robert Randolph.

HARTFORD—Ray H. Morris, Harold F. Sprague, Reynold F. Svensk, C. J. Umlauf.

INLAND EMPIRE — Dana W. Smith.

LEHIGH VALLEY—Jess Fellows Clarke, Justin W. Foster, M. L. Fox, Earl S. Gingrich, John H. Goolsby, Parker P. King, Arthur J. Koch, Robert D. Stout.

LONG ISLAND—Charles T. Williamsen.

LOS ANGELES—C. D. D'Amico, Leroy W. Davis, Sune Hermanson, K. L. Herrmann, Walter F. Hirsch, Jos. T. Ryerson & Son, Inc., George W. Whitney, John E. Wilson.

MAHONING VALLEY — United States Steel Corp.

MIAMI—Herbert M. Frazier.

MILWAUKEE — V. A. Aschenbrener, Edgar L. Harris, Harry K. Ihrig, Maynard Electric Steel Casting Co., John F. Schaifer, Merrill A. Scheil, Sivyer Steel Casting Co., William O. Smyth, Soren Sorenson, Austin R. Townsend, Wilson D. Trueblood, Carl J. Zilch.

MINNESOTA—Carleton C. Hitchcock, C. M. Underwood.

MONTREAL — A. E. Cartwright, Empire Brass Foundry, Ltd., Jacques Royer, Irenee Vachon.

INTERNATIONAL — Ernest W. Cox, George H. Davison.

NEW HAVEN—H. F. DeLacour, Farrel-Birmingham Co., Inc., Franklin Farrel, R. H. Leach, Enoch C. Richardson.

NEW JERSEY — Alfred Bornemann, H. J. Brucker, Crucible Steel Co. of America, Henderson Emanuel, John L. Everhart, John H. Fancher, Quintin Henderson, Daniel Mapes, Arthur J. Miller, Peterson Steels, Inc., Joseph F. Polak, Eugene Roth, Sandvik Steel, Inc., Stanton Umbreit, Floyd H. Wasser.

NEW YORK—Howard S. Avery, Herschel V. Beasley, Albert P. Gagnebin, George O. Hiers, H. R. Isenburger, E. R. Patton, E. J. Pedersen, Maurice L. Pinel, G. W. Place, William P. Winsor.

NOTRE DAME — Henning Klouman.

OAK RIDGE—Lawrence K. Jetter.

ONTARIO — Boiler Inspection & Ins. Co. of Canada, Otis Elevator Co., Ltd.

PEORIA—Wallace Bornholdt, John W. Bridwell, E. W. Langenberg, Walter H. Lenz, A. V. Martens, E. R. Meyer, Roy D. Michael, Glenn Thiersch.

PHILADELPHIA — Dominick F. Armiento, Joseph E. Carney, John A. Casner, T. E. Conklin, E. P. Higgins, Stewart Huston, John A. Jones, Lukens Steel Co., Edward J. Moran, Howard C. Myers, Jr., Ross M. Pfalzgraff, John S. Roberts, Sun Oil Co.

PITTSBURGH—A. R. Altman, J. Richard Benner, Sterling T. Boyd, Fred H. Bremmer, John P. Brosius, Maurice W. Daugherty, Charles T. Eakin, George C. Evans, Howard J. Eyman, D. W. Fletcher, Eric K. Foss, Russell Franks, Albert A. Frey, John H. Frye, Burns George, Malcolm F. Judkins, James A. Kearney, Arthur R. Kommel, Sol Kreisberg, Philip M. McKenna, Charles G. Merker, Mike A. Miller, Henry D. Nickol, Louis W. Oswald, Herman H. Schmitt, L. A. Shea, E. G. Unrath, H. H. Walkup, A. W. Wilson, I. Stanley Wishoski.

PUGET SOUND—Gilbert S. Schaller.

ROCHESTER — Henry H. Brown, Burke Steel Co., Inc., Charles W. Griswold, Fred E. Hall, Leon C. Kimpal, Justus Larson, Lawrence Lenhardt, John L. Petz, Jacob R. Phillippsen, Rudolph J. Velepec.

ROCKFORD—Ralph S. Johnson.

ROCKY MOUNTAIN—T. C. Jarrett Co.

SAGINAW VALLEY—Adolph T. Peters.

SAN FERNANDO VALLEY—Edwin F. Green.

ST. LOUIS—B. James Cahill, Wilbur A. Peters.

SPRINGFIELD — Matthew J. Donachie, Francis G. Jenkins.

SYRACUSE—Walter L. Hodapp.

TEXAS — Mission Manufacturing Co.

TOLEDO—Ohio Fuel Gas Co.

TRI-CITY—H. N. Bristow, Charles A. Davis, Leonard J. Engels, A. E. Sandberg.

WARREN — Robert S. Clingan, Emil Dubeck.

WASHINGTON—Reginald S. Dean, Robert B. Nation, George A. Pleam.

WEST MICHIGAN — William J. Boggs, Howard A. Horner.

YORK—William F. Allen, Bruce A. Jabsen.

Announce Translation Of Russian Journal

By arrangement with the Department of Scientific and Industrial Research, The Iron and Steel Institute is undertaking the monthly publication of a complete English-language version of *Stal'* (*Steel*), starting with the issue of January 1959. *Stal'* is the major Russian periodical in the sphere of iron and steelmaking technology in which many of the more significant developments are reported.

Published price per subscription (12 monthly issues) is 20 12s (Approx. $58). Subscriptions should be sent to: The Secretary, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1, England.

On Nondestructive Testing

John Battema, Jr. (Right) Spoke on "Nondestructive Testing and Its Functions in Modern Industry" at a Meeting Held by the York Chapter. He is shown with Earl Hagan, program chairman for the chapter

Speaker: John P. Battema, Jr.

Ferro-Spec Laboratories, Inc.

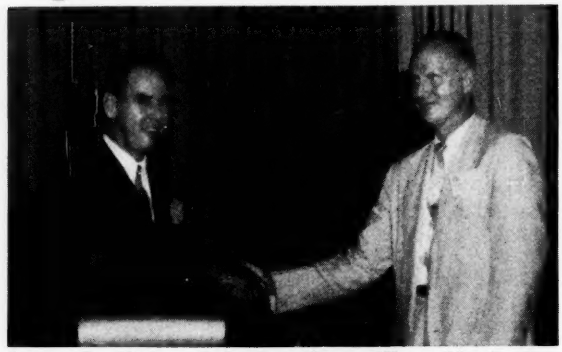
John P. Battema, Jr., laboratory director of Ferro-Spec Laboratories, Inc., talked on "Nondestructive Testing and Its Function in Modern Industry" at a recent meeting held by **York Chapter.**

With the aid of slides, Mr. Battema discussed the use of nondestructive testing as a quality control tool. The aircraft industry has been a leader in the field due to the nature of the products involved. However, other industries have found many uses for nondestructive testing.

Mr. Battema stated that the nondestructive testing was crude before 1930. Since then, great strides have been made. A basic nondestructive test is, of course, visual inspection for surface defects. Other methods include ultrasonics, magnaflux, zyglo and radiography. Mr. Battema went on to illustrate by slides the various equipment used to perform the tests mentioned.

Nondestructive testing for quality control is primarily a comparison to known standards. These standards are established after a great deal of testing and laboratory checking to confirm what actually exists on and in the part in question. The speaker described and illustrated equipment being utilized at present. As the design criteria become more critical, changes in nondestructive testing methods become necessary to meet the needs of industry.—**Reported by N. Stengel for York Chapter.**

Speaks on Vacuum Melting



James D. Nisbet, Left, President, Allvac Metals Co., Who Spoke on " Vacuum Melting and Casting of Metals and Alloys" at a Meeting of Carolinas Chapter, Is Shown Shaking Hands With W. Austin, Vice-Chairman

Speaker: James D. Nisbet

Allvac Metals Co.

James D. Nisbet, president, Allvac Metals Co., spoke on "Vacuum Melting and Casting of Metals and Alloys" at a meeting of the **Carolinas.**

Mr. Nisbet described the various types of vacuum melting equipment presently employed and the limitations of each type. He then discussed the growth of vacuum induction melted alloys and projected growth into new fields and development of new alloys.

In addition to the improved cleanliness and physical properties achieved by vacuum induction melting in existing metals and alloys, there are limitless combinations, such as normally volatile elements, that can produce alloys not obtainable otherwise.

The growth and use of vacuum induction melted alloys will continue to expand in new fields where its use has been restricted in the past by prohibitive cost.—**Reported by W. K. Hile for the Carolinas Chapter.**

A Good Time Is Had by All

The Tradionally Good Crowd Which Enjoys the Golden Gate Annual Golf Outing, Held Jointly With the Santa Clara Chapter, Is Again Evident in the Above Picture. Of the 212 members who played golf, Charles Fitzwilson had a low gross of 68, John Anderson had a low net of 77-8-69. Tom and Sonny Hutton were hosts. (Reported by Anson Averell for Golden Gate)

Use of Materials for Air Superiority Syracuse Topic

Speaker: L. D. Richardson

Wright Air Development Center

Lloyd D. Richardson of the Wright Air Development Center, spoke on "Materials—the Key to Air Superiority" at **Syracuse.**

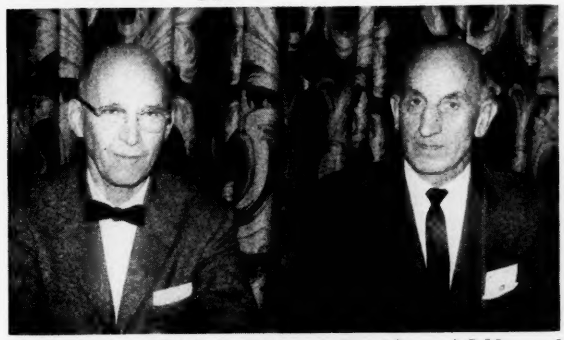
Mr. Richardson discussed the various conditions and phenomena existing at high altitudes which must be met and overcome by the use of materials, heat resistance being of primary importance. If materials of desired properties are not available, designers are forced to resort to cumbersome structures.

Environmental effects were also discussed. The effect of radiation, ozone formation, and the indirect effects of zero gravity plus the effect of some materials under extremely high temperatures were also illustrated.—**Reported by G. Trojanowski for Syracuse.**

Speaks at San Fernando

Earl R. Parker, University of California, Presented His Campbell Memorial Lecture on the "Flow and Fracture of Metals" at a Meeting Held by the San Fernando Valley Chapter. Shown at the speaker's table are, from left: Al Levy, technical chairman; Prof Parker; and Don Roda, the 1957-58 chairman of the Chapter

National Officers at Pittsburgh



C. H. Lorig (Right), National President A.S.M., and R. H. Aborn, Treasurer A.S.M., and Director of the Edgar C. Bain Laboratory, U. S. Steel Corp., Were Guests at the National Officers Night Meeting in Pittsburgh. Dr. Lorig presented his talk entitled "Selection of Materials in This Changing World"

Southeast Ohio Chapter Briefed on Toolsteels

Speaker: G. A. Roberts
Vanadium Alloys Steel Co.

Past-president George A. Roberts, vice-president, technology, Vanadium Alloys Steel Co., spoke at **Southeast Ohio** on "Toolsteels".

Dr. Roberts reviewed the development and use of high-speed toolsteels and explained how the industry is constantly striving to turn out a better product.

High-speed tools were first developed about 1890 to speed up machining operations by use of cutting tools which could operate at a high temperature and cut harder metals. One of the best-known types, containing 18% tungsten, 4% chromium and 1% vanadium, came into use in 1910. This was the predominant high-speed steel until World War II when a shortage in tungsten resulted in increased use of steels containing molybdenum. After World War II, the 18-4-1 steels again predominated for a short period, but after the Korean struggle, they were relegated to a secondary position.

More recently super high-speed steels have been developed which contain up to 5% each of vanadium and cobalt. These steels are far superior to the former high-speed steels in wear resistance and cutting ability. The improved properties are due primarily to the hardness of the vanadium carbide which is present in larger quantities than in the older steels.

Addition of sulphur to toolsteel has practically no effect on the tensile strength and yield point and lowers fatigue strength only slightly. While resulphurized toolsteel is more easily machined, it is valued most because of the better surface obtained.

Recently developed modifications of toolsteels are being used for structural purposes in such applications as high-speed jet fighters and missiles. One of these, containing 5% Cr, 1.5% Mo, 0.5% V and 0.4% C, has a tensile strength up to 190,000 psi. at 1000° F. This alloy has a tensile strength up to 190,000 lb. per sq. in. at 1000° F. This alloy has a higher strength : weight ratio than any other engineering alloy at temperatures up to 1000° F. There appears to be a bright future for alloy steels of the toolsteel type for use in high-speed jet aircraft and missiles.—**Reported by H. W. Rathmann for Southeast Ohio Chapter.**

Covers Need for Standards For Space Age at Baltimore

Speaker: A. T. McPherson
National Bureau of Standards

At a meeting of the **Baltimore Chapter,** A. T. McPherson, National Bureau of Standards, discussed the need for new and more precise "Standards for the Space Age".

Materials and components of missiles and satellites from hundreds of different sources must be made to the same highly accurate and uniform standards in order to fit together and function reliably. Because accuracy in parts per million is now so important, the National Bureau of Standards and the national laboratories of five other countries have agreed to adopt an international inch and an international pound instead of several slightly different inches and pounds formerly used. The platinum-iridium prototype meter bar is no longer sufficiently precise for scientific and industrial purposes and may soon be replaced by an atomic wave length standard of length by international agreement. The Bureau's atomic frequency and time standards have been improved and are now broadcast with a precision of about 2 parts per 100 billion at the source.

Standard samples of accurately determined constants and properties issued by the Bureau include many of interest to metallurgists such as new spectrographic standards for titanium alloys and new standards for gases in metals. Highly uniform specimens for control in stress-rupture testing are being developed in cooperation with ASTM and ASME. —**Reported by John A. McKay for Baltimore.**

Missile Power Requirements Subject of Carolinas Meeting

Speaker: S. P. Smith
Douglas Aircraft Co., Inc.

Sheldon P. Smith, general manager, Charlotte Division, Douglas Aircraft Co., Inc., spoke at **Carolinas Chapter** on "Missile Power Plants, Guidance Systems and the Need for New Metals and Alloys".

The high temperatures developed by aerodynamic heating, as well as power plant heating, demand materials not yet at hand. Refrigeration, high-temperature coatings, heat reflecting surfaces and high-temperature metals must be investigated to meet each of the heating problems.

Mr. Smith discussed different types of power plants, from the pull of gravity through advance rocket engine developments utilizing solid and liquid fuel types and involving exhaust temperatures from 4000 to 7000° F. He described the use of atomic and ionic power plants for space travel. Exhaust temperatures for the ionic or plasma jet range from 15,000 to 30,000° F. The propulsion for the future in outer space may be the photonic plant which utilizes a jet of photons or little bundles of light. Theoretically it is possible to approach the speed of light with this source of energy.

The speaker also reviewed the missile guidance systems commonly employed and gave a detailed explanation of the inertial guidance system.

Talks on Aircraft Nuclear Propulsion

J. R. Lewis (Center), General Electric Co., Presented a Talk on "Aircraft Nuclear Propulsion" at a Meeting of York Chapter. Shown, at left and right, are E. Hagan and J. Carey, program chairman and meeting manager

Speaker: J. R. Lewis
General Electric Co.

J. R. Lewis, Supervisor, Fuel Development Unit of General Electric Co., talked on "Aircraft Nuclear Propulsion" at a meeting of **York Chapter.** With the aid of slides, Dr. Lewis explained the basic principles and problems involved in an aircraft nuclear propulsion system. General Electric scientists and engineers are constantly bringing closer to reality nuclear wonders which would have been considered sheer science fiction only a decade ago. The unlimited flight potential of nuclear-powered aircraft makes inevitable the eventual development of such an aircraft.

Materials to satisfy necessary conditions is a big item in the program and present many problems. The application of the materials varies with the type of system. The direct-air-cycle system of aircraft nuclear propulsion has been intensively studied by General Electric.

With regard to principles of operation, the following basic requirements must be considered: (1) creation of nuclear fission; (2) conversion of fission to heat; (3) conversion of nuclear heat to thrust; (4) design of machinery to control the rate of heat generation and heat conversion; (5) shielding for protection of nuclear radiation; and (6) remote-handling equipment and facilities.

The reactor is usually a cylindrical body with a fissionable material, such as U^{235} or Pu^{239} distributed throughout. It contains passages for flow of coolant necessary for heat removal and a "moderator" which slows down the neutrons formed in the fission process and allows more efficient use of the reactors.

There are three basic sections into which the work falls—research, development and pilot operation. It is necessary that all three continue their work diligently to enable this nation to perfect nuclear systems that will propel aircraft.

Sustaining members and past chairmen of the York Chapter were honored at this meeting. William F. Allen was presented a 25-year membership certificate.—**Reported by N. Stengel for York Chapter.**

Discusses Inclusion Formation in Steel At Baltimore Chapter

Speaker: Walter Crafts
A.S.M. Vice-President

National Officers' Night of the **Baltimore Chapter** featured a talk by Walter Crafts, vice-president A.S.M. and associate director of technology, Electro Metallurgical Co., on "Inclusion Formation in Steel".

Inclusions are generally derived from two sources: one major type is the result of limited solubility for nonmetallic constituents as the metal cools and solidifies; the other, usually more harmful, is caused by entrapment and retention of inclusions resulting from mechanical or chemical erosion of refractories. Sometimes these types are interrelated so that it is difficult to isolate the primary and secondary causes and determine a corrective treatment.

Oxide products of deoxidation are usually eliminated rapidly by flotation soon after the deoxidizer is added. The oxygen residual is still in solution in the molten metal as is the sulphur, the other major constituent of inclusions. During cooling and solidification the solubilty for oxygen and sulphur are reduced and inclusions are formed in types and proportions consistent with iron-oxygen-sulphur-deoxidizer phase diagrams. These relations can be expressed schematically in ternary diagrams even though they are too complex for construction of true representation of the systems. The oxide part of such a system usually contains a miscibility gap with an oxide constituent that is rejected either as a solid or liquid during cooling. Usually sulphur is somewhat more soluble in the liquid and is found primarily in the eutectic phase at the end of solidification. The iron-oxygen-sulphur system is well understood and additions of manganese have been studied in 1% manganese alloys. In the more complex systems containing silicon, aluminum, etc., inferences can be made from the known data to permit the construction of schematic diagrams that are helpful in designing deoxidation treatments. In general, treatments are designed to avoid segregations of oxides in wrought steels and intergranular sulphides in cast steels. Avoidance of large enclosures of nonmetallics depends on good steel-making practice.

Difficulties in control of inclusions of the normal type usually result from exceptions to the generalized concept or from what appear to be extra-equilibrium factors. One case is the failure of deoxidation products to break through a slag-metal interface, so that subsequent turbulence, as in the reversion to a boil of a blocked heat, causes the steel to be dirty. A bottom boil seems to be harmful in a similar way. Another major influence is that steel inherits a tendency toward oxidic inclusions, if it was relatively high in oxygen prior to deoxidation, even though the residual oxygen is consistent with the deoxidizing treatment. This is observed in the relatively dirty condition of steels that were recarburized as compared with those in which the carbon was caught on the way down and in the relative cleanliness of steels given in initial deoxidation with silico-manganese. Strong initial deoxidation also results in improved yield of product with a good surface. A similar type of behavior, but in which the high initial oxygen condition is beneficial, is seen in steel castings that are relatively free from intergranular inclusions and have higher ductility if the metal is deoxidized from a strongly oxidized condition.

Large "slag" enclosures usually originate in the ladle and runner brick refractories. Part of this material results from mechanical erosion and entrapment in solidifying metal, as in the case of "ganister" that is scoured out from a well around the nozzle. The refractory material usually reacts chemically with the metal with transfer of manganese from metal to the refractory aluminum-silicate. High-oxygen steels are more corrosive and their attack can be minimized by a very slight deoxidation and subsequent reboil that eliminates the deoxidizing agent. Low temperatures will cause retention in the bottom half of the ingot of material that normally floats up to the top and is eliminated in the top discard.—**Reported by John A. McKay for Baltimore.**

Speaks on Aluminized Steel at Calumet

Nonferrous Night Meeting of the Calumet Chapter Featured a Talk on "Aluminized Steel" by Ross B. Hildebrand (Center), Pig and Ingot Products Office, Kaiser Aluminum & Chemical Sales, Inc. G. L. Armstrong, technical chairman, is shown at left, E. K. Phares, chairman, is at the right

Speaker: R. B. Hildebrand

Kaiser Aluminum & Chemical Sales, Inc.

Ross B. Hildebrand, program coordinator, pig and ingot product office, Kaiser Aluminum & Chemical Sales, Inc., spoke on "Aluminized Steel" at a meeting in **Calumet.**

The aluminum industry, long considered a competitor of the steel industry, has now found a product that is opening new markets for both aluminum and steel. The past ten years of intense study and development work by many of the leading steel producers has brought a fuller realization of the advantages and vast markets available for aluminized steel sheet and wire products.

Aluminized steel consists of an aluminum layer which provides corrosion resistance, color and luster, an intermediate zone of hard, brittle, heat resistant intermetallic compound which forms the metallurgical bond between the coating and the steel, and the base metal which may be plain carbon or alloy steel.

Aluminum is used to coat steel for the following major reasons: corrosion resistance, particularly in sulphurous atmospheres; heat resistance; appearance, decorative purposes; reflectivity, reduced heat absorption; elimination of dissimilar metal contacts where steel and aluminum components are used in fabrications; and as a base for other metallic coatings.

The primary use of aluminized steel is as a replacement for galvanized products and the aluminum industry estimates an annual market for 100 million pounds of aluminum in the production of aluminized steel products.

Coating thicknesses of aluminized and galvanized steels are approximately the same, falling in the range of one to four mils, but aluminum will cover a greater surface area for a given coating thickness because of its greater specific volume. Aluminum is not subject to atmospheric deterioration as is zinc and aluminized steel may therefore carry a thinner coating for many applications. The ductility of aluminized coatings permits cold working operations. Since the steel is softened at the high temperatures used in the aluminizing process, cold working is sometimes necessary to restore strength and is also used to brighten the coating and reduce the thickness. Tests indicate that aluminized steel is more weldable than galvanized steel but not as readily solderable.

The most common coating methods are the batch hot dip and continuous processes which require a metallurgically clean steel surface prior to immersion in the coating bath. Cleanliness of the steel has been one of the most difficult problems to solve in aluminizing. In one of the processes the steel is slightly oxidized and the oxide is subsequently reduced in a heated hydrogen atmosphere to form a layer of highly reactive elemental iron which reacts readily with the aluminum to form an adherent bond. Other processes utilize pickling, heating in inert atmospheres or molten barium chloride-sodium chloride salt baths.

Aluminum coating alloys depend on the end use of the coated product. The two alloys most widely used at the present time are commercially pure aluminum and 6-12% silicon bearing alloys. Commercially pure aluminum is the most widely used and is required where heat resistance is a factor.—**Reported by R. D. Engquist for Calumet.**

Reviews Heat Treating of Alloy Steels

George A. Fisher, Jr., International Nickel Co., Gave a Talk on "New Concepts of Alloy Steels and Their Heat Treatment" at a Meeting in Texas. Shown are, from left: Joe B. Marx, chairman; Mr. Fisher; and Franz R. Brotzen, secretary-treasurer. (Photograph by L. V. Dolan)

Speaker: G. A. Fisher, Jr.

International Nickel Co.

George A. Fisher, Jr., supervisor, St. Louis Section, International Nickel Co., spoke at a meeting of the **Texas Chapter** on "New Concepts of Alloy Steels and Their Heat Treatment".

Mr. Fisher discussed some of the basic concepts of heat treating and their effects on the properties and structures of steels. He stressed the effect of tempering temperature and tempering times on notch toughness, noting the different behavior of various alloy steels with respect to their temper embrittlement. He also stressed the effect of carbon and alloy content on the ductile-brittle transition temperature, emphasizing the beneficial properties of low carbon steels in this connection. Physical properties of ultra-high strength steels and those of several stainless steels were also included.

Information concerning precipitation hardening types of steels was also presented. Mr. Fisher emphasized the good tensile and impact properties of such steels, as well as their good creep and corrosion behavior. The absence of dimensional change during hardening of precipitation hardening steels was cited as one of their beneficial properties. Mr. Fisher closed with a discussion of some of the specific applications of nickel steels in high load applications where carburized and hardened surface conditions were necessary.—**Reported by D. B. Masson for Texas.**

Presents Talk on Aluminum Finishes

S. J. Sansonetti, Reynolds Metals Co., Presented a Talk Entitled "Aluminum Finishes" at a Meeting of Richmond Chapter. Shown are, from left: W. B. McMullin, membership committee chairman; W. F. Smith, secretary; Sam Tour, guest from the New York Chapter; J. A. Burke, Jr., chairman; Mr. Sansonetti; and J. W. Carson, technical chairman of the meeting

Speaker: S. J. Sansonetti
Reynolds Metals Co.

Members of the **Richmond Chapter** heard a talk on "Aluminum Finishes" by S. J. Sansonetti, assistant director of metallurgical research, Reynolds Metals Co.

Mr. Sansonetti classified finishing techniques into six broad groups—mechanical, chemical, plated, painted, porcelain enameled and anodized. Mechanical finishing was described as a "texturizing" process. Many textures are easily produced in aluminum because of its high workability which makes roll embossing, blasting, hammering, brushing, etc., economical to perform. In conjunction with "texturizing" the other finishes are often applied to further enhance appearance or utility.

Recent strides made in plating of aluminum products, particularly with respect to silver plating, have been instrumental in expanding the uses of aluminum in electrical buss bar and switch gear applications.

Chromium plating of aluminum has been made quite easy. Aluminum, which has been cleaned by a special treatment, is immersed a few minutes in a chem-nickel bath to plate a uniformly thin layer of nickel. This is then plated in the conventional chromium plating baths. Aluminum can be hard chrome plated for applications where abrasion resistance is required or it can be buffed to a bright mirror finish where decorative appeal is the most important consideration.

Chemical finishing was described as a relatively new field in which rapid advances are being made. Conversion coatings integrally produced on aluminum surface by building up complex chromium-aluminum phosphates are colorful, protective and permanent. The surface compounds are formed by immersion of aluminum in complex chemical solutions. The colors now available are somewhat limited, but the possibility of producing complex oxide coatings may broaden the range of colors in the future.

Some of the other chemical finishes mentioned included deep etching to develop interesting grain patterns, used in conjunction with color anodizing for automotive interiors, and chemical brightening of certain alloys by immersion in concentrated phosphoric-nitric acid solutions. Reflectivities as high as 97% that of a silver mirror are possible by this treatment.

Mr. Sansonetti emphasized the importance of proper preparations of aluminum before painting. Aluminum must be chemically treated to produce a phosphate coating if lasting paint adherence is to be obtained.

Porcelain enameled aluminum building panels are expected to become widely used in curtain wall construction because they combine two materials advantageously. Their production consists of applying low-firing temperature lead glass frit mixed with coloring oxides as a water slurry to aluminum and then firing the coated panel at 1000° F. to fuse the enamel. This combination yields a product with the appeal and permanence of porcelain and light weight of aluminum for ease of handling in construction. The inherent corrosion resistance of the aluminum backing also prevents spalling of the porcelain at exposed edges such as drilled holes and shear cuts.

Mr. Sansonetti then discussed the production and physical characteristics of anodic coatings in aluminum. Abrasion resistant anodic coatings differ from those produced primarily for corrosion resistance by being amorphous aluminum oxide instead of aluminum oxide monohydrate. Small differences in anodic cell operation determine which will be produced. Aluminum oxide is essentially colorless and the many colors available in anodized aluminum products are imparted by dyes. Dyeing is possible because there are about 500 billion pores per sq. m. of anodized surface. The pores occur in the center of hexagonal crystals of the aluminum oxide monohydrate. The dye is sealed into the pores by a hot water treatment. Lack of color fastness of most dyes somewhat limits the colors suitable for outside use, but practically a full spectrum of colors is available in color anodized aluminum for interior use where sun fading is not encountered.—**Reported by Samuel E. Eck for Richmond.**

Past President Guest at Worcester

Past National President George A. Roberts, Vanadium Alloys Steel Co., Spoke on "High-Temperature Alloys" at the Past Chairman's Night Meeting Held by Worcester Chapter. Shown are, from left: Edward J. Dolan, technical chairman; Dr. Roberts; and L. Krasnow, who presided

Meet Your Chapter Chairman

MINNESOTA

MORRIS E. NICHOLSON joined A.S.M. as a student member in 1937 and has been a continuous member since, except for the years he was on active duty as captain in the Ordnance Department during World War II. He is now a major in the Ordnance Corps Research and Development Reserve.

Born in Indianapolis, Mr. Nicholson is a graduate from the Massachusetts Institute of Technology with S.B. and Ph.D. degrees in metallurgy. First work after college was in the engineering research department of Standard Oil of Indiana. He then became assistant professor at the Institute for the Study of Metals, University of Chicago, and is now professor and head of the department of metallurgy at University of Minnesota.

Previous chapter services include a term as vice-chairman. He helped to organize the Educational Program and was a member of the seminar committee. Past program chairman of the Metallurgical Society of A.I.M.E., he is also a member of other technical societies, usually along educational lines.

Mr. Nicholson has three sons, Morris 14, Robert 10 and Richard 5 years old. He is an adult leader of the Boy Scouts, secretary of the Falcon Heights Little League and an officer in the local P.T.A.

RHODE ISLAND

CLIFFORD S. EY, metallographer with Grinnell Corp., Providence, comes from Brooklyn. He graduated from Rhode Island State College with a B.S. degree in engineering, and attended Curtiss Wright Technical Institute where he was later employed. He also worked at Grumman Aircraft Engineering Co. and American Moistening Co. before taking his present position.

A former member of the chapter's executive committee, he has also been on the educational committee, was chairman of coffee talks, yearbook and program committees, and served as vice-chairman. He is a member of other technical and civic societies.

Mr. Ey belongs to a sailing club and is a sports car enthusiast, having won a number of races with his MG. He has been flying for many years and holds a commercial pilot's certificate. He was in active service for three years during the war and is now a major in the Air Force Reserve. He has two sons, Frederick and Thomas.

COLUMBUS

THOMAS L. CHASE is a native of Columbus and a graduate of Ohio State University with a degree in metallurgical engineering. He joined the Chapter as a student and has served as treasurer and vice-chairman.

Upon graduation he joined Williams & Co. as a salesman until 1951 when he joined Western Automatic Machine Screw Co. in Elyria as a metallurgist in their heat treating operations. He is now a partner in the Electric Heat Treating Co.

Tom is active in other technical societies, is a member of the Columbus Junior Chamber of Commerce and is completing his third year as secretary of the Board of Trustees of his church. Two years were spent in the U. S. Army during World War II, 17 months overseas.

His recreation is bowling and golf, and he hasn't missed a home game of Ohio State's football team since 1946. His wife Josie comes from Lorain, Ohio.

MOHAWK VALLEY

ERWIN E. DEIMEL was born in Dusseldorf, Germany, and came to the United States in 1927. He majored in metallurgical engineering at Columbia University where he received his B.S. and M.S. degrees. As research associate he studied low-temperature properties of steel at Columbia and later went to Utica Drop Forge & Tool Corp. as senior research metallurgist working with high-temperature alloys. At present he is product design engineer with the General Electric Co. in Utica.

Erwin has served three years on his chapter's executive committee, has been program chairman and vice-chairman. He is past secretary of the Mohawk Valley Science Council.

Social activities include membership in Kiwanis International, Girl Scout Committee (he has three daughters 6, 4 and 2 years old), and deacon of the Presbyterian Church.

WICHITA

HARLEY E. BABST was born in Clayton, Kan., and graduated from Seaman High School, Topeka. His first employment was with Santa Fe Railroad in Topeka. He was affiliated with Bowes Seal Fast Co. until 1942, at which time he organized and became president of the Metal Finishing Co., Inc.

A member since 1948, he has held offices of secretary, treasurer and vice-chairman. Mr. Babst is also active in the Manufacturer's Club and is past-president of the American Electroplaters' Society. He takes an active part in civic affairs through the Y.M.C.A. and Young Life organizations.

Mr. Babst enjoys boating with his two children, DeAnn and Robert, and indulges in hunting and fishing when he has free time.

LONG ISLAND

ROBERT M. PLATZ has been a member of A.S.M. for ten years. Born in Flushing, N. Y., he obtained his degree in chemistry from Polytechnic Institute of Brooklyn in 1940 and took his first job at Republic Steel, Buffalo. He is now assistant chief, Materials Laboratory, Fairchild Engineering Division, Deer Park.

Mr. Platz served on the A.S.M. Handbook Committee concerned with high-temperature alloy casting and he is a past chairman of the American Welding Society. His favorite sparetime occupation is boating with his three boys.

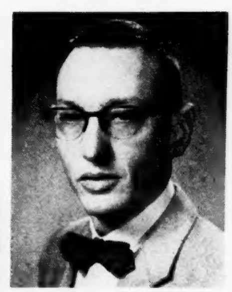
T. L. Chase

R. M. Platz

H. E. Babst

C. S. Ey

E. E. Deimel



Describes 9% Nickel Steel At Meeting in Ontario

Speaker: G. S. Farnham

International Nickel Co. of Canada, Ltd.

The metallurgical properties and potential uses of the new 9% nickel steel were outlined by G. S. Farnham at a meeting of the **Ontario Chapter.**

This steel possesses the following chemical analysis:

Carbon	0.13% max.
Manganese	0.60/0.90%
Phosphorous and sulphur	0.030% max.
Nickel	8.50/9.50%

The average mechanical properties in the as-supplied condition are as follows:

Tensile strength	110,000 psi.
Yield point	65,000 psi.
Elongation	25.0%
Reduction of area	65.0%

This steel possesses an Ac of 850° F. The heat treatment used to obtain the above properties is as follows: Normalize at 1650° F. to homogenize, re-normalize at 1450° F. for grain refinement, reheat to 1050° F. and air cool. During the final stage of heat treatment, the carbide diffuses into the austenite formed. The final structure consists of ferrite plus a high carbon austenite, which remains stable right down to the temperatures of liquid nitrogen. This confers upon the metal high ductility at low temperatures, providing a new, useful moderately priced metal for applications involving subzero temperature environments.

This 9% nickel steel has excellent hardenability and has been found to be potentially a good carburizing grade. Preference is shown for gas carburizing followed by cooling at relatively slow rates to minimize distortion. It has been possible to develop a case hardness of 58/60 Rockwell "C" by carburizing and cooling at 20° F. per hr. Oil quenching this material from the austenitizing range will provide a hardness of 36/38 Rockwell "C" in the core, while air cooling results in a core hardness of 28/30 Rockwell "C".

While the 9% nickel steel was originally designed for vessels carrying liquid air or nitrogen, its particular metallurgical properties are quite unique and may well lend favorably to other applications where carburizing with low distortion is an advantage, such as in the use of gears, shafting, plastic molds, etc.—**Reported by B. M. Hamilton for Ontario Chapter.**

Ottawa Valley Hears Talk On Cladding and Surfacing By Welding Techniques

Speaker: R. Zuchowski

Linde Co.

At a meeting of the **Ottawa Valley Chapter,** Robert Zuchowski, development engineer, Linde Co., Division of Union Carbide Corp., discussed "Cladding and Surfacing by Welding Techniques".

Mr. Zuchowski described three arc welding processes now being used extensively for cladding and surfacing. The choice of process is particularly dependent upon the desired degree of dilution of the deposit by base metal and upon the corresponding deposition rate.

High deposition rates are obtainable with the submerged arc process and the degree of dilution may be varied from high, with the direct arc single wire combination, to relatively low with the two-wire series arc combination. Controlled variations in deposit composition may be produced by the use of different filler wire alloys, tubular rods containing chromium or tungsten carbides, and mild or alloy steel filler wires in combination with bonded alloy type fluxes. A noteworthy accomplishment for the submerged arc process was the surfacing with stainless steel of the internal surfaces of a large heavy wall nuclear reactor vessel.

The inert gas metal arc process is also capable of high deposition rates. The degree of dilution may be reduced by automatic addition of filler wire, which is termed cold wire addition since no current is introduced through it. This addition results in a considerable increase in deposition rate. The cladding of cast iron paper mill rolls with nickel or the deposition of copper on military projectiles for subsequent machining of rotating bands are typical applications.

The tungsten arc process, having a lower deposition rate, is used primarily for hard facing or surfacing of small parts such as oil well tools. In this case, a cold wire addition is made in combination with automatic dispensing of tungsten carbide particles into the deposit. This results in retention of the sharp edges of the carbide particles, thus improving cutting ability.—**Reported by W. P. Campbell for Ottawa Valley Chapter.**

Describes Canaveral Missile Operations

Members of the Jacksonville Chapter Are Shown Listening to a Discussion on the Operation and Maintenance of the Air Force Missile Test Center at Cape Canaveral by Richard M. Gramling, Deputy Base Manager, Pan American World Airways, Cape Canaveral. He also covered information on the coordination and management of different missile launchings, including lunar probes. (Reported by Alvine L. Masterson)

Notes Canadian Progress in Far North

Robert Gordon Robertson, Deputy Minister, Northern Affairs and Resources, Presented a "Comparison Between Soviet and Canadian Developments North of the 60th Parallel" at a Meeting in Montreal. Shown are, from left: Keith Shaw, past chairman; Mr. Robertson; R. Thompson, chairman; and G. MacDonald Young, past chairman and past national president A.S.M.

Speaker: R. G. Robertson

Dept. of Northern Affairs and National Resources

At a meeting of **Montreal Chapter,** Robert Gordon Robertson presented a comparison between "Soviet and Canadian Developments North of the 60th Parallel". Mr. Robertson, deputy minister of Canada's Department of Northern Affairs and National Resources, pointed out that practically all of the Arctic lands are controlled either by the U.S.S.R. or by Canada. For this reason, northern research and development is of particular importance to these two countries. While Canada entered this field within the past five years or so, Russia has been active in its northern regions for over 30 years, so the Soviet Union is much further advanced and much can be learned from their achievements.

Since Canada and the U.S.S.R. are close neighbors, these areas are of vital strategic importance to all of North America. In addition, the Arctic regions have tremendous natural resources, the development of which can add materially to the wealth of the two nations. Fish, timber, coal, oil, iron, copper, lead, zinc, tin and nickel, as well as the noble metals, platinum and gold, are found there. Strangely enough, the primary hindrance to exploitation is not weather but the cost of transportation.

In both the U.S.S.R. and Canada, sea transportation is used to service coastal areas. In the U.S.S.R., the northern sea route is fairly well developed, but it is probably not economical as the Soviet seems to be decreasing its activities in this field. The answer, in the years to come, may lie with submarines, once they have been developed to the point where they can be used economically for commercial service. Inland transportation in both countries is by rail to the navigable portions of the northern rivers and then by water. In the U.S.S.R., transportation is already quite well developed because the Trans-Siberian Railroad and three main rivers have access to the Arctic coast.

Soviet development in the north has reached a more advanced stage than Canadian development for four reasons. First, the tree line is much farther north in the Soviet than in Canada. As a result, forestry resources are much greater in northern Russia. In addition, the 60° isotherm (average July temperature) is very little north of the 60th parallel in Canada. In the Soviet Union it is much farther north with resultant benefits in agricultural development. In addition, glaciation is less severe in northern Russia. Whereas Canada is largely rock-surfaced, the Soviet has extensive soil areas. Finally, the Soviet Union is subjected to much greater population pressure than is Canada, which has increased its incentive for northern development, resulting in a Russian population north of the 60th parallel of 4,200,000 in 1947, whereas, in Canada, the population was only 31,000 north of the 60th parallel as late as 1956. Russia thus has a number of cities north of the parallel with populations of a quarter of a million, Canada has only two communities with populations of over 3000.

On the lighter side, Mr. Robertson pointed out that in dealing with northern natives, the Soviet is basically taking capitalists (herdsmen) and endeavoring to convert them to communism. Canada, on the other hand, is endeavoring to convert Eskimos, who are basically communists, into capitalists.—**Reported by D. F. MacLeod for Montreal.**

Free Piston Engines Topic at Richmond

J. D. Fleming, General Motors Corp., Spoke on "Free Piston Engines" at a Meeting in Richmond. Shown are, from left: T. S. Daugherty, ways and means committee chairman; Dr. Fleming; J. A. Burke, Jr., chairman; L. G. Woody, coffee speaker; and G. E. Stein, education committee chairman

Speaker: J. D. Fleming

General Motors Corp.

J. D. Fleming, senior research engineer in charge of free piston engine development at the Research Laboratories, General Motors Corp., spoke at a meeting of the **Richmond Chapter** on "Free Piston Engines".

After a brief history of the development of the free piston engine and some of its early uses, Dr. Fleming gave a detailed description of the operating principles involved. The operational advantages of the free piston over other diesel engine types were listed as follows: high thermal efficiency, use of low quality fuels, low maintenance and repair, freedom from vibration and flexibility of application. Free piston engine use in air compressors and gasifiers in locomotives and ships was mentioned.

Dr. Fleming's presentation was followed with a short film showing the operation of a GM experimental car with a free piston engine.—**Reported by Patrick H. Woods for Richmond.**

Tour Western Ontario Glass Plant

"New Processes in Glass Production" Was the Title of the Technical Talk Which Followed a Tour of Dominion Glass Co. at a Meeting of Western Ontario Chapter. Shown are, from left: W. McIntyre, chairman; Bud Sutherland, chief engineer, Dominion Glass Co.; Frank Miller, Chapter executive board; and Tony N. Thomas, technical chairman of the meeting

On Cleveland Chapter's Gear Panel

A Panel Meeting on "Gears — Design, Manufacturing, Material Specification, Inspection and Quality Control, and Heat Treating" Was Held by the Cleveland Chapter. Members of the panel included, from left: H. J. Bates, Fairfield Manufacturing Co.; Russell Hoffman, Tool Steel Pinion and Gear Co.; T. A. Frischman, Eaton Manufacturing Co., Moderator; E. J. Wellauer, Falk Corp.; G. S. Collins, Clark Equipment Co.; R. E. Siegel, Fuller Manufacturing Co.; and K. J. Humberstone, Chairman

Past President Speaks at Purdue

G. M. Young, Immediate Past President A.S.M., Presented a Talk on "Light Metals in Heavy Industry" at a Meeting Which Was Held by the Purdue Chapter. Shown are, from left: A. L. Hurst, technical chairman; Mr. Young; C. T. Leamon, chairman; and E. G. Ridoux, vice-chairman

Stresses Proper Design For Failure Prevention

Speaker: E. J. Pavesic
Lindberg Steel Treating Co.

At a joint meeting of the **New York Chapters** A.S.M. and A.S.T.E., E. J. Pavesic, metallurgist, Lindberg Steel Treating Co., discussed "Failure Prevention Through Proper Design for Heat Treatment".

Mr. Pavesic stated that one authoritative source claims that 90% of all failures are due to faulty design or improperly executed design and only 10% to faulty material and heat treatment. It is hard to convince the design engineers of these figures because they often feel that failures result from fabrication, material or heat treatment errors. Rather than promulgate this argument, Mr. Pavesic strongly urged that each group involved in the manufacture of a part should recognize each other's responsibility and co-operate to the extent that the part that is produced be good enough to do the job for which it is intended at a reasonable cost.

Stress raisers or points of concentration of stress are responsible for failures in service as well as in heat treatment. Some stress raisers inherent in the design of a part are abrupt changes in section, inadequate fillets or sharp corners, sharp re-entrant angles, keyways, blind holes and threads.

In the process of fabrication of a part many stress raisers and/or residual stresses are introduced or built up which may affect service life or response to heat treatment (e.g., heavy roughing cuts, rough machined surfaces, deep tool marks, deep stamp marks, grinding defects such as burning or cracking, and nonuniform removal of the original mill bar surfaces which may contain scale, pits, seams and decarburization).

Heat treating is probably the most severe operation any "design" (part) has to go through. Some of the results of heat treating "bad designs" are cracking, warpage and high residual stresses. Faulty heat treating practices can destroy or doom to early failure the best of designs (e.g., decarburization might promote fatigue failure). Improper straightening practice can also introduce undesirable stresses which may lead to premature failure.

Mr. Pavesic's talk was illustrated with slides showing a diverse range of parts some of which failed in heat treatment and others in service. —**Reported by Oliver E. Olsen for New York.**

A.S.M. is the largest publisher of books for the metals industry in the world.

Letter From a Member

The letter below was received by A.S.M.'s president from a Distinguished Life Member, I. Melville Stein, and reflects the deep feeling members of the Society so often express after long years of A.S.M. membership.

"The American Society for Metals has greatly honored me by its award of Distinguished Life Membership and I very deeply appreciate this recognition.

"If you will permit me, I should like to take this opportunity to congratulate A.S.M. on the vision and foresight of its founders and on the outstanding success that you and the other leaders in the organization have had, not only in meeting but, in my judgment, far exceeding the goals set by the founders.

"I can well remember the modest beginnings of the Society and shall never forget the continuing enthusiasm, among its members, that the splendid leadership of the officers of the Society has inspired.

"It is hardly necessary for me to add that the outstanding success of the Society and the unusual enthusiasm among its members is a great personal tribute to the "one and only" Bill Eisenman.

"I am very proud of the fact that Leeds and Northrup Co., through the continuing activities of so many of its personnel, has been privileged to share in the growth and distinguished achievements of A.S.M."

I. Melville Stein, President
Leeds and Northrup Co.
Philadelphia, Pa.

Mahoning Entertains

The **Mahoning Valley Chapter** held its annual dinner dance on Valentine's Day in honor of the wives of the members.

The dinner was held in the Jade Room of the Mural Building in Youngstown, Ohio, with dancing afterwards to the music of the Fountos-Yarnell Orchestra. The dinner dance was attended by 50 couples.

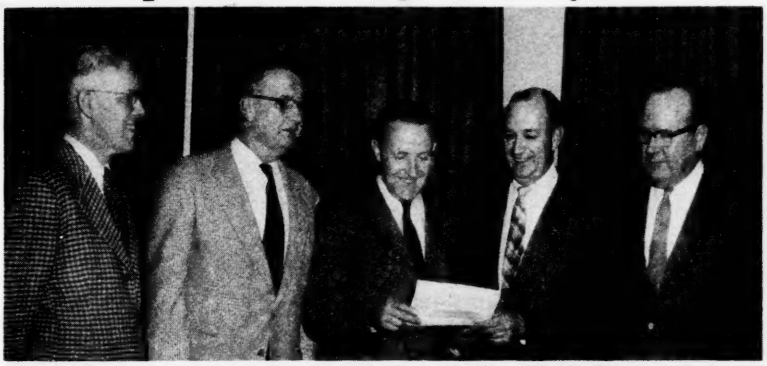
Joins A.S.M. Staff

Leonard R. Mehlman has joined the headquarters staff of A.S.M. as staff engineer assigned to the Castings Design Project. Until recently Mr. Mehlman was chief engineer of Prestole Corp., Toledo.

Leonard started in the foundry industry as a patternmaker, became a castings designer with Jack & Heintz during the war and subsequently was employed by Tinnerman Products as a product designer and later chief standards engineer before joining Prestole.

produces and makes available to chapters and educational institutions moving picture films pertaining to metals.

Set Up Science Congress in Syracuse

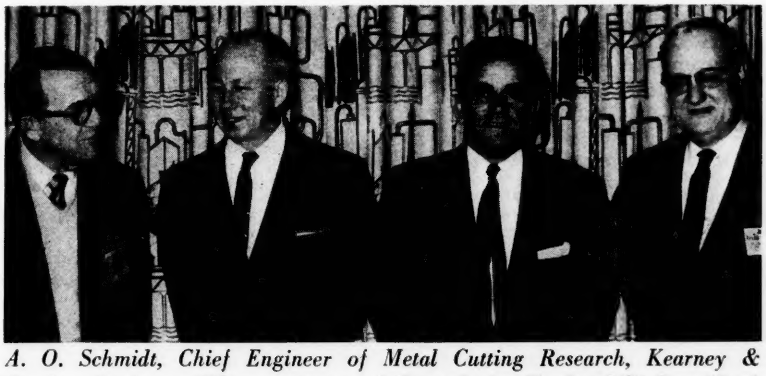


Shown Discussing the 11th Annual Central New York Science Congress Sponsored by the Syracuse Chapter and the Central Section of Science Teachers Association of New York State, Are, From Left: F. Gillet, S.T.A., R. N. Gillmor, Chairman, Student Affairs, C. Gardner, Director, Central Section S.T.A., H. Holbert, Chairman, and T. Davis, Representative, Technical Advisory Committee. (Reported by G. Trojanowski)

Springfield Combines Tour and Talk

Members of the Springfield Chapter Toured the Chain Belt Co., Conducted by J. D. Sloan, General Manager, Who Also Gave a Brief Talk on the Company's Activities. J. K. Nyburg, Metal Powder Div., Republic Steel Corp., later gave a talk on "Powder Metallurgy". Shown at the meeting are, from left: Fred I. Whipple, vice-chairman; Mr. Nyberg; and Albert F. Quern, Republic Steel Corp. (Reported by Sidney Spungin for Springfield)

Covers Hardenability at North Texas



A. O. Schmidt, Chief Engineer of Metal Cutting Research, Kearney & Trecker, Spoke on "Measurements and Controls for Hardenability" at North Texas. He also covered studies being undertaken by industry in the metal cutting field. Shown are, from left: J. E. Fowler, technical chairman; Mr. Schmidt; C. E. Perkins, chairman; and E. Casey, vice-chairman

Describes New Sintering Theory

Shown at a Meeting Held by the Los Alamos Chapter Are, From Left: William W. Martin, Chairman; Henry H. Hausner, Adjunct Professor, Polytechnic Institute of Brooklyn, and Consultant to Los Alamos Scientific Laboratory; and Donald E. Schell, Technical Chairman of the Meeting

Speaker: Henry H. Hausner

Consulting Engineer

Henry H. Hausner, adjunct professor at the Polytechnic Institute of Brooklyn, and consultant to Los Alamos Scientific Laboratory, gave a talk on a "New Sintering Theory in Powder Metallurgy" at a meeting of **Los Alamos Chapter.** This new theory of sintering may greatly affect the future development of powder metallurgy.

According to the speaker there are two different movements going on during sintering of a mass of metal powders: material movement due to diffusion which results in densification; and grain boundary movement due to recrystallization and grain growth which results in the final grain structure of the sintered material. Both movements are to a certain extent correlated and strongly affected by the porosity between the powder particles during the sintering process.

Dr. Hausner pointed out that the variables of porosity actually widely affect diffusion as well as grain boundary movement and that, therefore, the original porosity determines to a large extent the grain structure and the physical properties of the sintered product.

One can distinguish between more than ten variables in porosity, such as the total pore volume, total number of pores, pore size, pore shape, interconnected and closed pores, orientation of pores, etc. With respect to the change in pore size during sintering, the speaker referred to the work of Professor F. Rhines of Carnegie Institute of Technology, but emphasized that practically no consideration has been given heretofore to pore shape and pore orientation. Dr. Hausner stated that greater porosity and smaller pore size in the "green" compact contribute to a faster rate of material transportation during sintering, but at the same time to a rather smaller rate of grain boundary movement. He further explained the reasons for obtaining a more uniform grain structure by avoiding any orientation of the voids in the compact. The speaker claimed that this new theory, which stresses the heretofore neglected porosity, will permit production of powder metallurgy materials with closer control of, and probably better, physical properties.

According to Dr. Hausner, pressure-compacting probably decreases the rate of densification, and he noted the distinction between powder metallurgy products made by sintering of pressure-compacted and of loose powders, respectively. The experimental results of the speaker's work were used to illustrate and clarify the theory.

Reference was also made to the recently developed process of metal powder slip casting as a special case of nonpressed powders, and to the work of the United Kingdom Atomic Energy Authority on beryllium sintering which resulted in a new type of beryllium characterized by improved physical properties, especially with respect to ductility. — **Reported by H. D. Lewis for Los Alamos.**

National Trustee Guest at Buffalo

National Trustee John H. Hollomon, General Electric Co., Spoke on "New Developments in Metallurgy" at the Past Chairmen's Night Meeting in Buffalo. Present were, from left: Fred A. Webber, program chairman; Dr. Hollomon; National Vice-President, Walter Crafts, Electro Metallurgical Co.; Emil Galbreath, secretary; and Harry Jamesson, treasurer

Speaker: J. H. Hollomon

General Electric Co.

John H. Hollomon, A.S.M. National Trustee and manager of metallurgy and ceramics research department, General Electric Co., talked on "New Developments in Metallurgy" at the **Buffalo Chapter's** annual past chairmen's night meeting.

Dr. Hollomon first gave the members a look into the future of the A.S.M. and the metallurgist and pointed out how they could go to keep abreast of changing economic conditions. He then described how our economy has developed and attained tremendous productive capacity so that many metals are now plentiful and competing on an economic basis for use. Furthermore, plastic and ceramic manufacturing is now coming into large productive capacity and starting to compete with metals on an economic basis.

Because the fundamental laws governing the properties and production of metals, plastics and ceramics are the same, the education of the future metallurgist must teach him how these broad fundamental laws apply to all materials. The future metallurgist will thus be capable of considering all materials on an economic basis and not be biased by his lack of knowledge of any one type. He will become more of a materials engineer in view of his broader education.

Future progress in materials will depend on applying fundamental laws common to all materials to develop the possible but now unattainable superior properties which materials have.—**Reported by M. A. Grobe for Buffalo Chapter.**

Receives McFarland Award

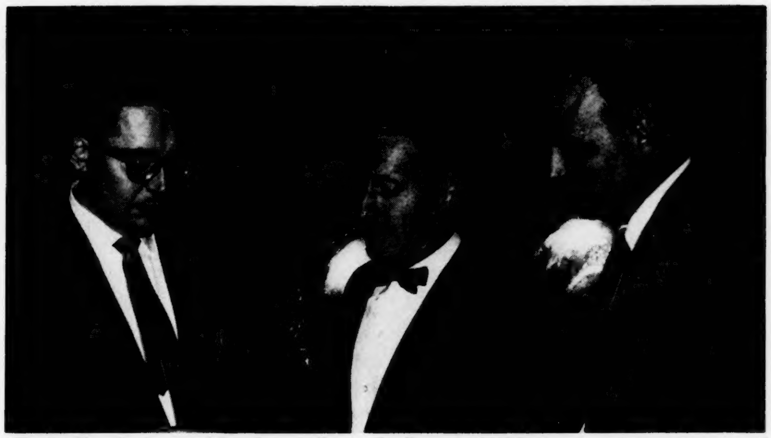
Robert D. Stout, professor and head of the department of metallurgy, Lehigh University, received the 1959 David Ford McFarland Award of the Penn State Chapter for his achievements in metallurgy. The award was established in 1959 by the Chapter to recognize metallurgy graduates of the University.

After obtaining his B.S. degree from Penn State in 1935, Dr. Stout served for four years as a metallurgical engineer with Carpenter Steel Co. In 1939 he was named to the faculty of Lehigh University where he enrolled in graduate studies that led to his M.S. degree in 1941 and his Ph.D. degree in 1955. He was named head of the department of metallurgy in 1956.

Dr. Stout has a large number of publications in the fields of weldability, mechanical metallurgy and brittle fracture of steel. He is coauthor, with W. D. Doty, of the book "Weldability of Steels". He has taken an active part in committee work in technical societies, and served many years as chairman of the University Research Committee of the Welding Research Council.

Dr. Stout has received many awards, including the Lincoln Gold Medal of the A.W.S. and the Teaching Award of the A.S.M.

Describes Electron Beam Techniques



Karl H. Steigerwald, Zeiss Optical Co. and Electrona, Inc., Presented a Talk on "The Machining and Welding of Materials by Electron Beam Techniques" at a Meeting of Savannah River Chapter. Shown are, from left: Dr. Steigerwald; G. W. Beckman, chairman; and R. F. Mittelberg

Speaker: K. H. Steigerwald

Zeiss Optical Co., Germany
Electrona, Inc., New York

Members and guests of the **Savannah River (South Carolina-Georgia) Chapter** enjoyed a talk on "The Machining and Welding of Materials by Electron Beam Techniques" by Karl H. Steigerwald, director of the electronics division, Zeiss Optical Co., Oberkocherr, Germany, and president of Electrona, Inc., New York.

The basic idea in electron beam cutting or welding is to direct a collimated stream of high velocity electrons in a vacuum at the material to be cut or welded. The success of the electron beam technique relies first on the ability to concentrate the energy on an extremely small area down to several microns in diameter. The second requirement is to be able to apply the energy for intervals of time measured in microseconds. The mechanism is to vaporize the material locally in such a short time that an extremely steep temperature gradient obtains in the metal. Localized temperatures up to 6000° C. are attained with this technique.

The machining possibilities of electron beam techniques were demonstrated by samples of steel and tungsten with holes of varying shape and size down to 30 microns in diameter. Holes have been successfully bored with diameters as small as 4 microns.

Dr. Steigerwald explained that, in electron beam welding, the parts to be welded are butted together and a slightly conical hole is bored between them with the electron beam. The metal is then melted locally along the entire depth of the hole. As the beam is indexed along the joint to be welded, the surface tension of the melted material causes it to fill the minute void without need for filler metal. The basic difference between conventional arc welding and the electron beam technique is that the former depends on melting from the surface for weld penetration whereas the electron beam melts simultaneously the entire interface to be welded. The electron beam technique is particularly advantageous in welding thin gage to massive materials.—**Reported by R. P. Marshall for Savannah River.**

Discusses Toolsteels at Milwaukee

"Understanding Toolsteels" Was the Subject of a Talk by R. J. Zale, Vulcan-Kidd Div., H. K. Porter Co., Inc., at a Meeting of Milwaukee Chapter. Shown are, from left: Scott Henry, chairman; Mr. Zale; Robert Rank, the coffee speaker; and A. F. Monfre, technical chairman

Speaker: R. J. Zale

Vulcan-Kidd Steel Div.
H. K. Porter Co., Inc.

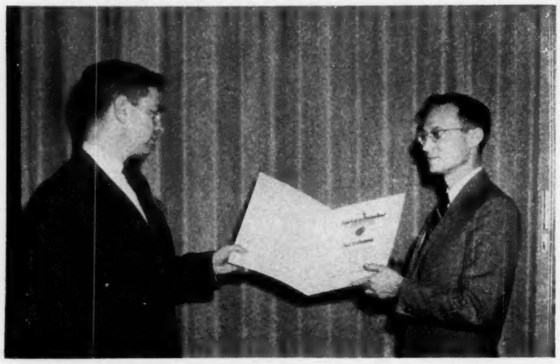
"Understanding Toolsteels" was the subject of a talk before the **Milwaukee Chapter** by R. J. Zale, general sales manager, Vulcan-Kidd Steel Div., H. K. Porter Co., Inc.

Mr. Zale stated that although only ½% of the total steel tonnage in the United States represents toolsteels, this amount is of critical importance because modern methods of high-speed production and automation depend on it. These steels are classified into 80 AISI types with over 100 modifications.

Many of the toolsteels are plain carbon grades with about 1% carbon, and the properties of these steels are adequate for many applications. However, they suffer from several drawbacks which limit their use, such as lack of dimensional stability in heat treatment and lack of depth of hardening.

Mr. Zale spoke on the alloying elements added in special grades of toolsteels to improve hardenability, hot strength, wear resistance and safety in heat treating, and to reduce finish grinding costs by minimizing distortion in heat treatment. In many cases an alloy toolsteel, although higher in initial cost, reduces the cost per part by increasing tool life.—**Reported by J. W. Quick for Milwaukee.**

Receives Geisler Award



J. H. Westbrook (Left), General Electric Co. Research Laboratory, Is Shown as He Received the Geisler Award of the Eastern New York Chapter From W. Childs, Technical Chairman of the Meeting

Presents Burgess Lecture

William A. Johnson (Left), Thompson Ramo Wooldridge Inc., Who Delivered the George Kimball Burgess Memorial Lecture on "Diffusion in Metals" at Washington, Is Shown With H. Bernstein, Naval Gun Factory

Speaker: J. H. Westbrook

General Electric Co.

J. H. Westbrook of the General Electric Co.'s Research Laboratory was honored with the 1959 Geisler Award at a recent meeting of **Eastern New York Chapter.** The Geisler Award is given annually to a young member of the Chapter for outstanding achievement in education, engineering, research, manufacturing or sales.

Dr. Westbrook's talk was entitled "Intermetallic Compounds—Some of Their Mechanical Properties".

Dr. Westbrook has designed and built a hot hardness tester and applied the apparatus to measuring the properties of many systems of refractory materials and high melting point compounds. This provides a method of studying the tensile strength of a material indirectly. The correlation between microhardness and tensile strength as a function of temperature seems to be consistent and therefore this hardness criterion can be used to study the mechanical properties of these hard and brittle intermetallic compounds. Interestingly, these materials do become somewhat ductile at high temperatures.

The speaker gave a brief history of the problems involved in identifying metallic compounds. He pointed out that the compounds are associated with maximum hardnesses and minimum electrical conductivity.

The factors that contribute to the strength of the compound include ordering and the size of the antiphase domains. The highest strength is attributed to a critical domain size. The temperature dependence of the strength is again related to the domain size. In those cases where disordering occurs at high fractions of the melting point, the material softens. Dr. Westbrook showed that, in all cases, the strength of the compounds can be associated with the lattice defect concentration. For example, the strength of aluminum-rich NiAl can be explained by the presence of the vacancies. At low temperatures, they impede the slip process, whereas at higher temperatures, where the deformation is diffusion controlled, the vacancies aid the deformation process and the material is weak relative to the stoichiometric composition.

Ternary alloys based upon intermetallic compounds are presently being investigated. It is hoped that the excellent high-temperature strength can be combined with adequate ductility by the proper choice of third element.—**Reported by Louis Ianniello for Eastern New York.**

Speaker: W. A. Johnson

Thompson Ramo Wooldridge, Inc.

The annual George Kimball Burgess Memorial Banquet of the **Washington Chapter** featured a lecture on "Diffusion in Metals" by William A. Johnson, associate director of research and development, Thompson Ramo Wooldridge, Inc.

Dr. Johnson pointed out the natural classification of diffusion studies into two categories: (1) engineering, and (2) theoretical. Studies of the first type yield engineering data on the gross phenomena; for instance a "diffusion coefficient" and an "activation energy" for the process may be determined. These parameters will be useful for predicting the results to be expected in the same system under other conditions. These types of data have been very valuable in enabling the prediction of results in diffusion controlled phenomena such as carburization, decarburization and austenite transformation. Therefore it is important that this type of study be continued.

In studies in the second category a theory is developed and mechanisms postulated. Much progress has been made in diffusion theory since Kirkendall's marker experiment in which he observed the migration of molybdenum wires marking the interface between a thick layer of electroplated copper and an enclosed brass bar. This historic experiment, together with the advent of radioactive tracers, brought in the concepts of two diffusion coefficients, one for each of the two species of elements in a binary system. These are known as the "intrinsic diffusion" coefficients.

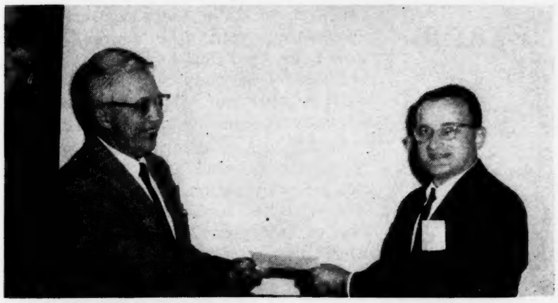
In the pioneer work of Johnson on the 50-50 gold-silver alloy, he obtained three separate straight lines in a Log-D vs. 1/T plot, the highest diffusion rate being obtained if a chemical concentration gradient is present, a lower value if the data were based on the counting of radioactive silver in a chemically homogeneous alloy, and the lowest, if based on the counting of radioactive gold in a chemically homogenous alloy.

This apparent discrepancy, he pointed out, was first resolved by Darken who obtained a relationship between the intrinsic diffusion coefficients and the chemical diffusion coefficient, involving the chemical activity and the mole fractions, by considering the chemical potential distribution in a nonideal solution. Johnson showed that the same relationship could be obtained by an atomistic random walk treatment.

Thomas G. Digges, chief of the thermal metallurgy section, National Bureau of Standards, received the first annual George Kimball Burgess Memorial Award. Mr. Digges was cited for his many contributions to the science of metallurgy, particularly in the field of hardenability and boron steels during his more than 35 years of service at the National Bureau of Standards.—**Reported by John R. Cuthill for Washington.**

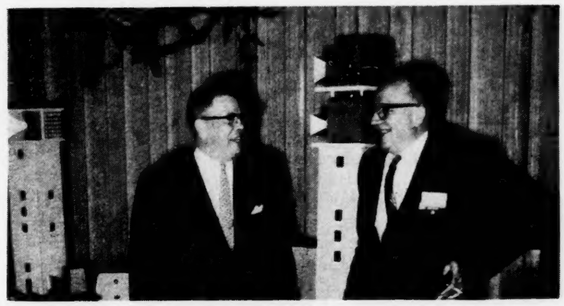
has created the Metals Engineering Institute, the home study school of the metals industry.

Defines Explosive Forming



A. H. Petersen, Lockheed Aircraft Corp., Is Shown at a Meeting of Washington Chapter (Left), Receiving a Scroll From Chairman Harold Bernstein. Mr. Petersen presented a talk on "Explosive Forming"

Television Transmission



R. C. Clark (Left), Bell Telephone Co., who Spoke on "Television Transmission" at a Meeting of the Mahoning Valley Chapter, Is Shown With Karl L. Fetters, Chapter Chairman and Past National Trustee

Speaker: A. H. Petersen

Lockheed Aircraft Corp.

The possibilities of "Explosive Forming" as a production method were outlined by Alfred H. Petersen, Lockheed Aircraft Corp., at a meeting of the **Washington Chapter.**

He referred to early work in the field, then stressed the importance and difficulty of obtaining quantitative data. The work discussed has been supported by the Manufacturing Methods Division of the Air Materiel Command. Emphasis was on understanding the mechanisms, not the production of parts.

The most successful applications of explosive forming, to date, lie in the field of bulging. Rocket cases, nose cones, cylindrical tanks and dished bulkheads have been produced in a number of materials with consistent success. Logical uses of the method are for the forming of welded light gage, heat-treated materials. Very close tolerances can be maintained. It is interesting to note that dies are not a problem. Segmented dies are needed (to permit removal of the part), but steel-lined concrete, kirksite or cast iron have all been used successfully.

The explosive charge can be set off in free air, in vacuum, or transmitted through a transfer medium such as water. A broad pressure front is desired. The interaction of reflected stress waves can either help shape the pressure pulse to assist the desired deformation, or more likely, interfere. An advantage of a transfer medium is that it acts as a buffer, prolonging the duration of the pulse. In this way, the size of the charge can be reduced about half.

Temperature measurements of the blank are acquired with difficulty, since, as would be expected, thermocouples are blown off. Indicated temperatures are several hundred degrees in less than a millisecond.

Work in this field requires the handling and storage of high explosives. Trained personnel and special facilities, such as safety tools, antistatic floors and explosion-proof utilities are needed. In addition, anyone planning such operations will have to deal at length with local and state bodies concerned with the enforcement of safety regulations. Obtaining approval for the use of facilities owned by the Services has been known to be somewhat time-consuming.—**Reported by Joseph R. Lane for Washington Chapter.**

Speaker: R. C. Clark

Bell Telephone Co.

Members of the **Mahoning Valley Chapter** heard Robert C. Clark, public activities supervisor for the Ohio Bell Telephone Co., Cleveland, give a lecture-demonstration on "Television Transmission".

In explaining and demonstrating the principles of radar and the use of microwaves in transmitting television pictures, Mr. Clark used special apparatus to show how microwaves may be reflected, bent, made to go around corners and concentrated into narrow beams.

He described Bell Telephone System's coaxial cable network now being installed across the nation to augment the radio relay system in carrying both network television programs and regular long-distance telephone messages from one city to another.

George Welsch, Jr., technical chairman, introduced the speaker and guided the technical discussion which followed the lecture.

Just prior to Mr. Clark's speech, Paul John Kovach, a junior metallurgical student at Youngstown University, was presented an A.S.M. Education and Research Foundation Scholarship. J. P. Fisher, head of the university's department of metallurgy, made the presentation and congratulated Paul on his achievements. Mr. Kovach is a very active member of the student chapter of the A.S.M. at the university.—**Reported by Edward J. Fromm for Mahoning Valley.**

Compliments

To ADAM M. STEEVER, life member of A.S.M., who is now enjoying himself in Sarasota, Fla., following his hobbies of fishing and photography. He retired in 1958 after 22 years as general superintendent of the Chicago Heights plant of Columbia Tool Steel Co.

He is a past chairman of the Chicago Chapter and he served on various committees for the A.S.M. Metals Handbook, and contributed articles to *Metal Progress* and *Transactions* on his specialties — forging, heat treating and furnace design.

He joined the Steel Treating Research Society (predecessor to the American Society for Metals) in Detroit in 1917.

♦ ♦ ♦

To AUGUSTUS B. KINZEL, vice-president research, Union Carbide Corp., who was presented the Stevens Institute of Technology Powder Metallurgy Medal on May 6, for outstanding achievement in the field of powder metals.

Dr. Kinzel delivered the Medal Lecture, entitled "Powder Metallurgy and the Microcosm".

♦ ♦ ♦

To CHARLES E. NELSON, technical director, Magnesium Dept., Dow Chemical Co., on his election as president of the American Foundrymen's Society for 1959-1960, and to ROBERT E. MITTLESTEAD, metallurgist, Lectromelt Casting Div., Akron Standard Mold Co., and JAMES N. WESSEL, supervisor, materials engineer, Puget Sound Naval Shipyard, who have been elected national directors of the A.F.S.

Mr. Mittlestead is a member of Akron Chapter, Mr. Wessel is a member of the Puget Sound Chapter A.S.M., and Mr. Nelson is a member of the Saginaw Valley Chapter.

Double Celebration

The M.E.I. staff has just passed another milestone in its growth. On the occasion of completing its second full year of operation as an educational institute it also awarded, to Otto Weinbaum, professor at Sao Paulo, Brazil's Instituto Tecnologica de Aeronautica, its 500th certificate. Dr. Weinbaum has just completed the course entitled **Metals for Nuclear Power**, after having previously completed the M.E.I. course entitled **Heat Treatment of Steel**. He is now enrolled in two other courses, **High-Temperature Metals** and **Survey of Steel Plant Processes.**

Otto Weinbaum

Enrollments in M.E.I. after two years of operation have just passed the 1750 mark. This includes about 1000 men and women studying as individuals, 500 persons studying in company-sponsored in-plant courses, and approximately 250 persons studying in extension classes sponsored by six local A.S.M. chapters.

Records show that about 40% of the enrollees already have B.S. degrees, and 60% have not been college trained.

Job titles of M.E.I. students range from works managers and vice-presidents to foremen, sales engineers, and shop workers and technicians.

Forty-four states and 23 foreign countries are represented in the M.E.I. student body. The prospects for the coming year seem particularly promising, since numerous companies and local chapters have already expressed a strong interest in using Institute courses for their technical education programs.

Surveys of home study students have shown:

1.) A majority got from the course what they expected.
2.) Practically all considered the time and money spent very worthwhile.
3.) About two-thirds reported more opportunities for advancement.
4.) About one-third indicated they were given greater job responsibilities.
5.) A small but surprising number reported almost immediate job advancement.

As one M.E.I. student put it, "After completing your fine course, I am now convinced that home study is the only practical way for a busy man with a full-time job to continue his education in an organized manner".

M.E.I. is now offering 17 metallurgical courses and an additional five are in preparation. The new courses are expected to be ready before the end of this year. Catalogs are available upon request.

M.E.I. headquarters would be pleased to receive inquiries from individuals and groups and will do their utmost to assist in the organization and enrollment of persons interested in sharpening their technical knowledge about metals.

Part of the M.E.I. Staff Is Shown Above as it Celebrates the Issuance of Its 500th Certificate on the Day of Its Second Anniversary as a Home Study School. Standing around M.E.I.'s director, Anton Brasunas, are (from left) Ted Holt, Jr., printing; Fred Siegrist, training supervisor; Ruth Vincent, registrar; Lewis Berger, training supervisor; Julie Buday, secretary; Winifred Henderson, secretary; Benton Schneider, instructor; and John Hajgato, draftsman. Not present when the photograph was taken were Eva Duzs, clerk; Maria Sipos, printing; John Duzs, artist; and Julia Sloan, records. (Photograph taken by Photo Service, Inc.)

Forty-Three Individuals Received M.E.I. Certificates at the Recent Graduation Ceremony Held in Los Angeles. The course, Elements of Metallurgy, had 20 enrollees and the course, Heat Treatment of Steel, had 23 enrollees. Courses were taught by Charles H. Dickson, left, and Bob Lundquist, right, standing, shown with students who received the certificates

Georgia Student Enrolls

Philip J. Duffy of Atlanta, as the first M.E.I. enrollee from Georgia, has been awarded one year's free dues on his A.S.M. membership. This bonus offered to the first registrants from states not represented on the "M.E.I. Flag" was made in *Metals Review* for April and is still open to residents of Alaska, Arkansas, Hawaii, North Dakota, South Dakota, Vermont and Wyoming.

Mr. Duffy is a district sales manager for Lindberg Engineering Co. of Chicago. His headquarters and home are in Atlanta. He has selected M.E.I. Course 10, **Heat Treatment of Steel,** for his home study program.

For further information about M.E.I. see page 34 of this magazine.

The 14th METALLOGRAPHIC EXHIBIT

Chicago, November 1 to 6, 1959

*All metallographers—
everywhere—
are cordially invited to
display their best work.*

RULES FOR ENTRANTS

Exhibitors do not need to be members of the American Society for Metals.

Work which has appeared in previous metallographic exhibits held by the American Society for Metals is unacceptable.

Photographic prints should be mounted on stiff cardboard, extending no more than 3 in. beyond edge of print in any direction; maximum dimensions 14 by 18 in. (35 by 45 cm.). Heavy, solid frames are unacceptable.

Entries should carry a label on the *face of the mount* giving:

Classification of entry.

Material, etchant, magnification.

Any special information as desired.

The name, company affiliation and postal address of the exhibitor should be placed on the *back of the mount* together with a request for return of the exhibit if so desired.

Entrants living outside the United States should send their micros by first-class letter mail endorsed "Photo for Exhibition—May Be Opened for Customs Inspection".

Exhibits must be delivered before Oct. 15, 1959, either by prepaid express, registered parcel post or first-class letter mail, addressed:

Metallographic Exhibit
American Society for Metals
53 W. Jackson Blvd.
Chicago 4, Ill., U.S.A.

CLASSIFICATION OF MICROS

Class 1. Cast irons and steels
Class 2. Carbon and alloy steels (wrought).
Class 3. Stainless steels and heat resisting alloys.
Class 4. Aluminum, magnesium, beryllium, titanium and their alloys.
Class 5. Copper, nickel, zinc, lead and their alloys.
Class 6. Uranium, plutonium, thorium, zirconium and reactor fuel and control elements.
Class 7. Metals and alloys not otherwise classified.
Class 8. Series showing transitions or changes during processing.
Class 9. Welds and other joining methods.
Class 10. Surface coatings and surface phenomena.
Class 11. Slags, inclusions, refractories, cermets and aggregates.
Class 12. Electron micrographs.
Class 13. Results by unconventional techniques.
Class 14. Color prints in any of the above classes. (No transparencies accepted.)

AWARDS AND OTHER INFORMATION

A committee of judges will be appointed by the Metal Congress management which will award a First Prize (a medal and blue ribbon) to the best in each classification. Honorable Mentions will also be awarded (with appropriate medals) to other photographs which in the opinion of the judges closely approach the winner in excellence. A Grand Prize, in the form of an engrossed certificate and a money award of $500 from the Adolph I. Buehler Endowment will also be awarded the exhibitor whose work is judged best in the show, and his exhibit shall become the property of the American Society for Metals for preservation and display in the Society's national headquarters.

All prize-winning photographs will be retained by the Society for one year and placed in a traveling exhibit to the various Chapters.

41st NATIONAL METAL CONGRESS & EXPOSITION

INTERNATIONAL AUDITORIUM — — — CHICAGO — — — NOV. 1 to 6, 1959

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad. Address answers: c/o A.S.M., 7301 Euclid Ave., Cleveland 3, O., unless otherwise stated.

POSITIONS OPEN

East

METALLURGICAL ENGINEERS (TWO): With up to three years experience, to fill recently created research and development positions. Conventional and advanced areas in powder metallurgy being investigated for private and government sponsors. Work is being carried out in newly set-up laboratory located in Metropolitan area of New York, specifically, Queens. Send resume to: Storchheim Research & Development Corp., 34-32 57th St., Woodside, N. Y.

METALLURGIST: B.S. degree required, with none to two years experience in nonferrous metals. Must have good understanding of fundamental metallurgy concerning cold work hardening and grain size control. Trainee will work under supervision of metallurgical department and spend majority of time on process control and related investigations. Opportunity for advancement in an expanding brass mill. Send resume and salary requirements. Box 5-5.

SUPERVISOR OF TESTING: Graduate engineer preferred, with up to three years experience, to take charge of all testing aspects for newly established metallurgical research and development laboratory. Facility located in Metropolitan New York area, specifically Queens. Address all replies to: Storchheim Research & Development Corp., 34-32 57th St., Woodside, N. Y.

FOUNDRY METALLURGIST: With B.S. degree, or equivalent technical knowledge, with experience in ferrous foundry operations, capable of establishing controls for electric furnace melting and supervising metallurgical laboratory. Desire person who has served apprenticeship in gray iron foundry, with practical knowledge of molding, core making and heat treating, capable of assuming full charge of expanding metallurgical department and interested in attractive, long-term opportunities. Salary open depending on experience. Fringe benefits above average, with noncontributory surgical, hospitalization and profit-sharing program. This is an immediate opening in Hagerstown, Md., with no traveling required. Box 5-160.

Midwest

RESEARCH—ELECTROPLATING: Science or engineering graduate, minimum B.S. degree, to do electroplating research in modern laboratory located in suburban Pittsburgh. Experience desirable but not necessary. Salary commensurate with training and experience. Box 5-140.

FERROUS PROCESS AND PHYSICAL METALLURGISTS: With one to five years experience in iron and steel industry, to work with expanding research and development organization in large and extremely diversified steel producing facility. Openings available for metallurgical engineers familiar with and having a working knowledge of blast furnace, sintering plant and various steel producing processes, rolling mills and product physical metallurgy. B.S. degree required. If you desire a challenging assignment with opportunity for professional growth and advancement, send complete resume to: Box 5-145.

METALLURGIST: Two years college or equivalent in metallurgical or engineering field, to coordinate metallurgical lab operations to meet company product requirements, supervise work of technicians, prepare and issue detailed reports, maintain lab stocks and equipment to insure efficient operation. Requires high degree of initiative, sound judgment, resourcefulness, training in metallurgical lab procedures. Must be able to recommend promotions, releases, transfers, disciplinary action, promote harmonious relationships within the group. Should be budget minded. Minimum five years in metallurgy and physics involving physical and chemical tests on metals and alloys, experience in such operations as casting of ferrous and nonferrous metals and heat treatment, metallography, and ability to read and interpret specifications and instructions, compile and evaluate data, recommend necessary changes. Salary \$550 to \$675 a month. Box 5-150.

West

TEACHERS (TWO): For department of metallurgy. One department head, Ph.D. preferred, physical or process metallurgy. Teaching and research. Rank and salary dependent on qualifications. Apply: President, Montana School of Mines, Butte, Mont.

AIRCRAFT PROCESS ENGINEER—METALLURGIST: B.S. or M.S. in metallurgical engineering, or chemical engineering with specialization in metallurgy, desired. Key opening requires several years of materials and process engineering experience in the missiles/aircraft field including ferrous metallurgy, aluminum and magnesium metallurgy and metal processing (platings, conversion coatings,

organic finishes). This unusual opportunity requires ability to deal persuasively with engineering, manufacturing and vendor personnel at all levels of management. Please phone or send resume to: G. F. Michels, TExas 0-7111, Ext. 4377, Hughes Tool Co., Aircraft Div., 11940 W. Jefferson, Culver City, Calif.

Foreign

GRADUATE ENGINEERS: Metallurgical, mechanical, electrical, etc., with steel mill experience. Family living quarters furnished in South America. Short preliminary period in New York followed by two year contract. Include resume in confidential reply to: Ramseyer & Miller, 11 W. 42nd St., New York 36, N. Y.

POSITIONS WANTED

METALLURGICAL ENGINEER: B.S. degree, age 34, family. Three years experience in research and development with large manufacturer, primarily in ferrous metallurgy, including product development, material selection, heat treatments, physical testing and failure analysis. Box 5-10.

PHYSICAL METALLURGIST: Student, married, age 23, B.S. degree expected in May 1959. Experience in metallographic analysis, X-ray diffraction, radiation effects on materials, ferrous and nonferrous physical metallurgy. Taking M.S. degree next year. Desires summer employment in metals field anywhere in Canada or U. S. Available May to October. Box 5-15.

MATERIALS ENGINEER: B.S. degree, graduate study. Application and development in toolsteels, stainless steels, nonferrous casting, heat treatment, tool and die troubleshooting. Publications, patents. Imaginative but practical. Clear, concise report writing. Age 31, married, family. Desires senior engineering or supervisory position as materials expert. East Coast preferred but will consider other locations. Box 5-20.

METALLURGICAL ENGINEER: Seeking responsible position as welding engineer. Five years production experience, one in research. Detailed knowledge of welding, heat treating and inspection of most commercial products. Skilled in preparation of reports and specifications. Available about Aug. 1. Box 5-25.

METALLURGICAL ENGINEER: Ph.D. degree. Six years experience in research and development of high-temperature alloy steels and two years in electron tube technology. Age 38. Seven technical papers. Licensed professional engineer. Desires managerial position in research and development of refractory metals and alloys. Box 5-30.

METALLURGICAL ENGINEER: M.S. degree, additional studies in economics. Age 30, married. Eight years experience in nuclear reactor manufacturing as an engineer, foreman and general foreman; supervised vacuum melting, extrusion, rolling, forging, machining, pickling and welding operations. U. S. or overseas. Minimum salary $12,000. Box 5-35.

METALLURGIST: B.S. degree. Six years practical and applied experience in missile fabrication, material and manufacturing development of steels, high-strength and high-temperature alloys, titanium, nickel, aluminum and magnesium alloys. Welding, heat treating and forming. Specifications. Properties. Positions considered: senior development engineer or supervisor of metallurgical laboratory. Box 5-40.

PHYSICAL METALLURGIST: Ph.D. degree, age 35, family. Seven and one-half years experience in research and industry in alloy development, high-temperature materials, vacuum melting, powder metallurgy. Supervisory experience and technical report writing. Desires position with responsible firm offering opportunity for professional development. Box 5-45.

TECHNICAL EDITOR: Degrees in Arts and Business; night engineering school (metallurgy) for four years; acquiring wealth of engineering and administrative experience in most phases of editorial work and advertising space sales. Writer, age 37, aiming for challenging, responsible editorial or public relations position. Location unimportant (anywhere in U. S. or Canada). Box 5-50.

METALLURGICAL ENGINEER: M.S. degree, family. Nine years research experience. Desires position in West. Resume on request. Box 5-55.

METALLURGICAL ENGINEER: B.S. degree, naval officer engaged in aircraft maintenance, will complete military obligation in August. One year experience in steel mill

Senior Chemists, Physicists, Metallurgists and Engineers for

FUEL ELEMENT DEVELOPMENT

Fuel Materials. Senior Physical Metallurgists and Chemists for research and development of reactor fuels. Research in gas-metal systems, emphasis on structural, phase equilibria, and material properties.

Alloy development of fuel and cladding materials for operation in power reactors up to temperatures of 1200°F. and higher.

Study radiation effects, overall evaluation of uranium and alloys and ceramics.

Fuel Fabrication. Senior Metallurgical, Mechanical and Chemical Engineers for fabrication development of materials and elements. Includes both rod-type and plate-type elements and complex assemblies. Development of non-destructive tests for these elements.

Irradiation Experiments and Hot Lab Evaluation. Senior Physicists, Chemists and Engineers to develop and conduct irradiation experiments to establish the behavior of fuel materials and prototype fuel elements under conditions of temperature and radiation anticipated in full scale power reactors. Also Senior personnel to develop techniques and equipment for the post-irradiation testing and evaluation of these experiments.

Write today for more details about exciting career opportunities: Mr. D. E. Newton, Personnel Office, Atomics International, 21600 Vanowen Street, Canoga Park, California.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.

training. Interested in locating on West Coast or Rocky Mountain areas. Age 25, married. Box 5-60.

METALLURGICAL ENGINEER: B.S. degree, age 26, married. Two years experience in research and development with high-temperature materials. Midwest location preferred. Box 5-65.

HEAT TREAT SUPERVISOR: Age 40, married, family, veteran, two years college, four years apprenticeship in heat treating, two extension courses in metallurgy. Twenty years experience, ten years as supervisor, in hardening, normalizing, annealing, case hardening, alloy, carbon steels, high-speed toolsteels, flame hardening bars, gears and ways, atmosphere furnaces, maintenance furnaces and generators. Desires supervisory position in Midwest. Box 5-70.

METALLURGIST: B.Ch.E. degree, age 42. Five years experience in trouble-shooting for U. S. Naval Ordnance Laboratory. Performed microscopic examinations of surfaces, sections, fractures, X-ray micrographic plates, etc., and interpreted significance of microscopic observations in terms of metallographic structure, fabrication procedure, etc. Will consider any location. Box 5-75.

METALLURGICAL ENGINEER: Met.E. and M.B.A. degrees (industrial management major), age 28, married, family. Desires responsible and challenging position with opportunity for managerial growth. Three years experience in conducting metallurgical research and five years cooperative work in process

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METALLURGICAL ENGINEER: B.S. and M.A. degrees, age 30, family. Seven years experience in research and precision forging industry. Experience includes high-temperature alloys, titanium, die steels, all phases of physical and metallurgical testing. Presently supervising large production laboratory. Desires responsible position in research or development in Midwest. Box 5-85.

PHYSICAL METALLURGIST: M.E. degree with advanced studies. Married, family, veteran. Experience in research and development, several papers. Exceptionally broad experience in machine tools and experience in development of new alloys, corrosion, fabrication. Seeks position of challenging nature with opportunity for administrative experience and advancement. Will relocate. Resume on request. Box 5-90.

METALLURGICAL TECHNICIAN: Will receive B.S. degree in chemistry in July. Desires responsible position in Chicago, Detroit or Cincinnati areas. Ten years widely varied experience, research and process control, in metallurgy of steel, white and gray cast iron, malleable iron, nodular iron, aluminum; mechanical testing, radiography and spectroscopy. Age 35, family. Box 5-95.

METALLURGIST: B.S., M.S. degrees. Fifteen years laboratory supervisor for producer of automotive and aircraft components. Experience as plant metallurgist and product engineering. Liaison metallurgist in stampings, castings, forgings, screw machine products, weldments, die castings, corrosion prevention, surface coatings, electroplating, pickling, grit blasting, shot peening, heat treating, carburizing and nondestructive testing. Box 5-100.

METALLURGIST: Twenty years experience in fabricated metals includes structural steel, bridges, pressure vessels, storage tanks, weldments and field erection. Background heavy in administrative sales and engineering. Extensive practical experience estimating, marketing, purchasing, production control and labor negotiations. B.S. in metallurgical engineering, early 40's, married, two fine children. Detailed resume on request. Box 5-105.

SALES AND SERVICE REPRESENTATIVE: Metallurgist with varied experience in heat treating, plating, metal finishing and corrosion prevention, would like to represent progressive company with quality products. Cincinnati area. Salary and commission. Box 5-110.

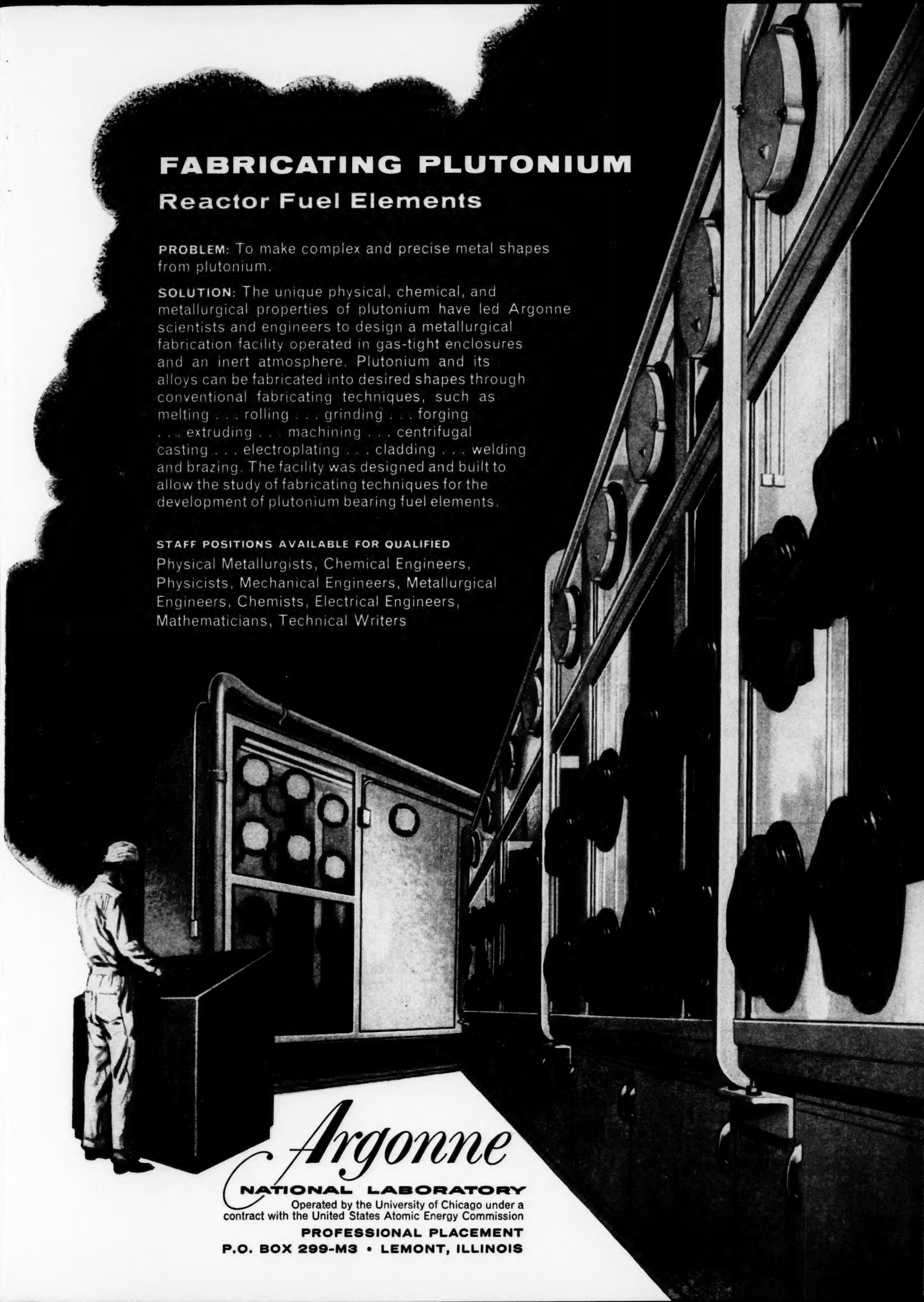
METALLURGIST: B.S. degree, age 36, married, family. Nine years specialized and supervisory experience in wrought ferrous alloys, including heat treating, quality control and laboratory. Clear, concise technical reports and specifications. Qualified for production, plant or chief metallurgist position, preferably with bearing manufacturer or commercial heat treat concern. Box 5-115.

ASSISTANT OR WORKING SUPERVISOR: Presently employed, moving to Phoenix, Ariz., for wife's health. Twenty years with present company, twelve years in heat treat, control, maintenance. Troubleshooter on gas carburizing furnaces and generators; gas analysis; carbon potentials; case checks. Straightening, induction, cyanide. Experienced in teaching new men and supervision in above operations. Age 45. Box 5-120.

CHEMIST: Presently working in Greece on theoretic research in cosmic rays, their derivation and composition, their importance to the problem of space vehicles. Seeks responsible position to enable further research. Age 27, B.A. in chemistry, Italian university. Box 5-125.

MASS SPECTROMETRY: B.S. geophysics, geochemistry, June 1959. Age 27, veteran, family. Laboratory experience in metallurgy, nuclear geology and electronics. Prefers employment along these lines. Interested in laboratory or plant work. Would like to settle new university facilities. Box 5-130.

PHYSICAL METALLURGIST: B.S. degree and advanced courses in metallurgy at M.I.T. Experience in metallography, heat treatment, supervising programs concerning heat treating of toolsteels and stainless steels of martensitic types, evaluation of fabrication processes, precision investment casting and mechanical testing, including foundry metallurgy. Prefers Illinois. Box 5-135.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SOLUTION: The unique physical, chemical, and metallurgical properties of plutonium have led Argonne scientists and engineers to design a metallurgical fabrication facility operated in gas-tight enclosures and an inert atmosphere. Plutonium and its alloys can be fabricated into desired shapes through conventional fabricating techniques, such as melting . . . rolling . . . grinding . . . forging . . . extruding . . . machining . . . centrifugal casting . . . electroplating . . . cladding . . . welding and brazing. The facility was designed and built to allow the study of fabricating techniques for the development of plutonium bearing fuel elements.
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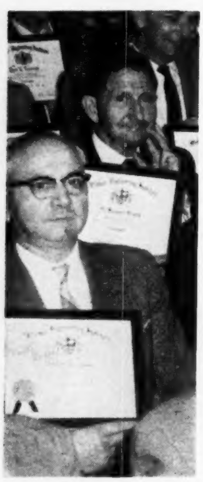

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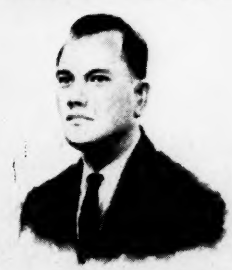

Physicist John A. Bistline, a graduate of Rollins College (1944), has specialized in High Temperature Critical Facilities at KAPL. He came here in 1948 after receiving his MS in Physics from Cornell. Previously he worked with the Metallurgical Laboratory, University of Chicago, and the Los Alamos Laboratory, University of California. Mr. Bistline is now the physicist in charge of operation of the Proof Test Reactor.

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